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**Peter**

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(54) **SEED FIRMER LIFE EXTENDER  
MOUNTING BRACKET**

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**Related U.S. Application Data**

(63) Continuation of application No. 15/405,923, filed on Jan. 13, 2017, now Pat. No. 10,201,123, which is a continuation-in-part of application No. PCT/US2016/066214, filed on Dec. 12, 2016, and a continuation-in-part of application No. 14/627,096, filed on Feb. 20, 2015, now Pat. No. 9,908,222, which is a continuation-in-part of application No. 14/012,246, filed on Nov. 4, 2013, now Pat. No. 9,565,797, which is a continuation-in-part of application No. 13/862,698, filed on Apr. 15, 2013, now abandoned.

(60) Provisional application No. 62/312,221, filed on Mar. 23, 2016, provisional application No. 62/278,081, filed on Jan. 13, 2016, provisional application No. 62/018,173, filed on Jun. 27, 2014, provisional application No. 61/942,225, filed on Feb. 20, 2014, provisional application No. 61/642,004, filed on May 3, 2012.

(51) **Int. Cl.**  
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*A01C 7/12* (2006.01)  
*A01C 7/06* (2006.01)  
*A01C 5/06* (2006.01)  
*A01C 23/02* (2006.01)  
*F16M 13/02* (2006.01)

(52) **U.S. Cl.**  
CPC ..... *A01C 7/12* (2013.01); *A01C 5/068* (2013.01); *A01C 7/06* (2013.01); *A01C 23/023* (2013.01); *F16M 13/02* (2013.01)

(58) **Field of Classification Search**  
CPC ..... B25B 27/02; A01C 5/068; A01C 7/20  
USPC ..... 29/270  
See application file for complete search history.

(56) **References Cited**

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\* cited by examiner

*Primary Examiner* — Lee D Wilson

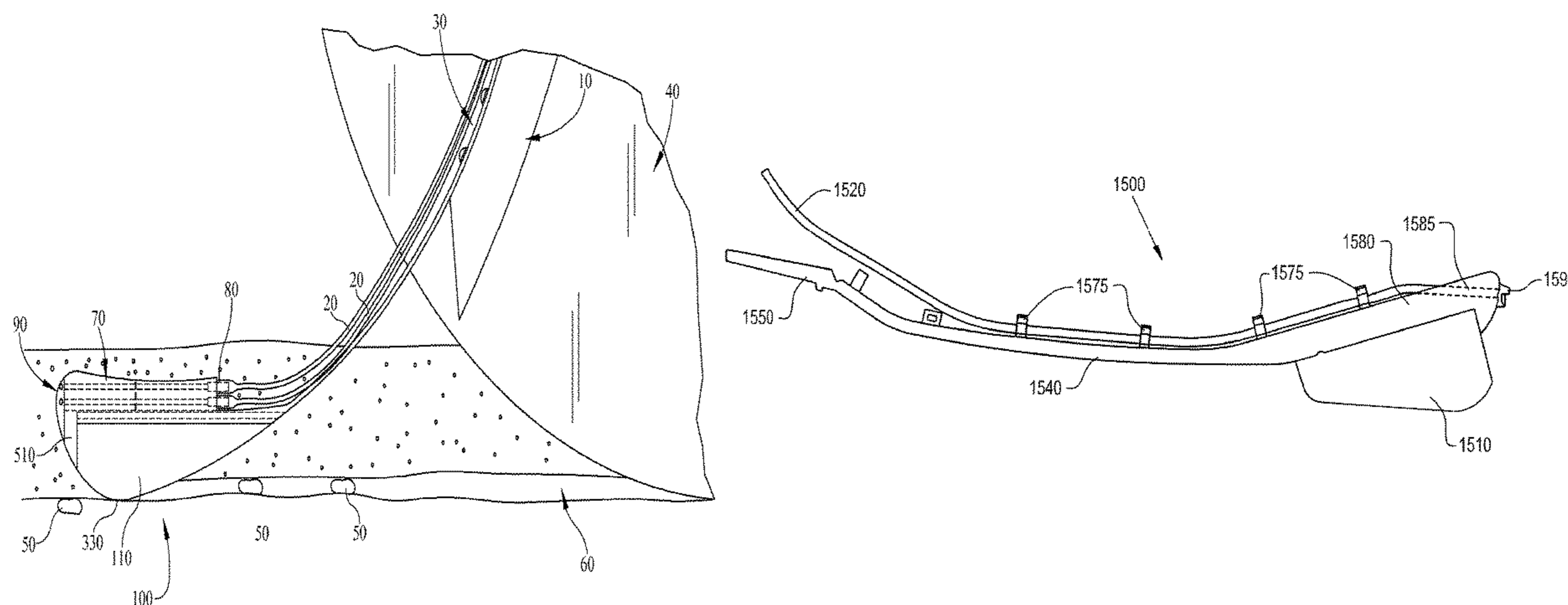
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Brannon Sowers & Cracraft PC

(57) **ABSTRACT**

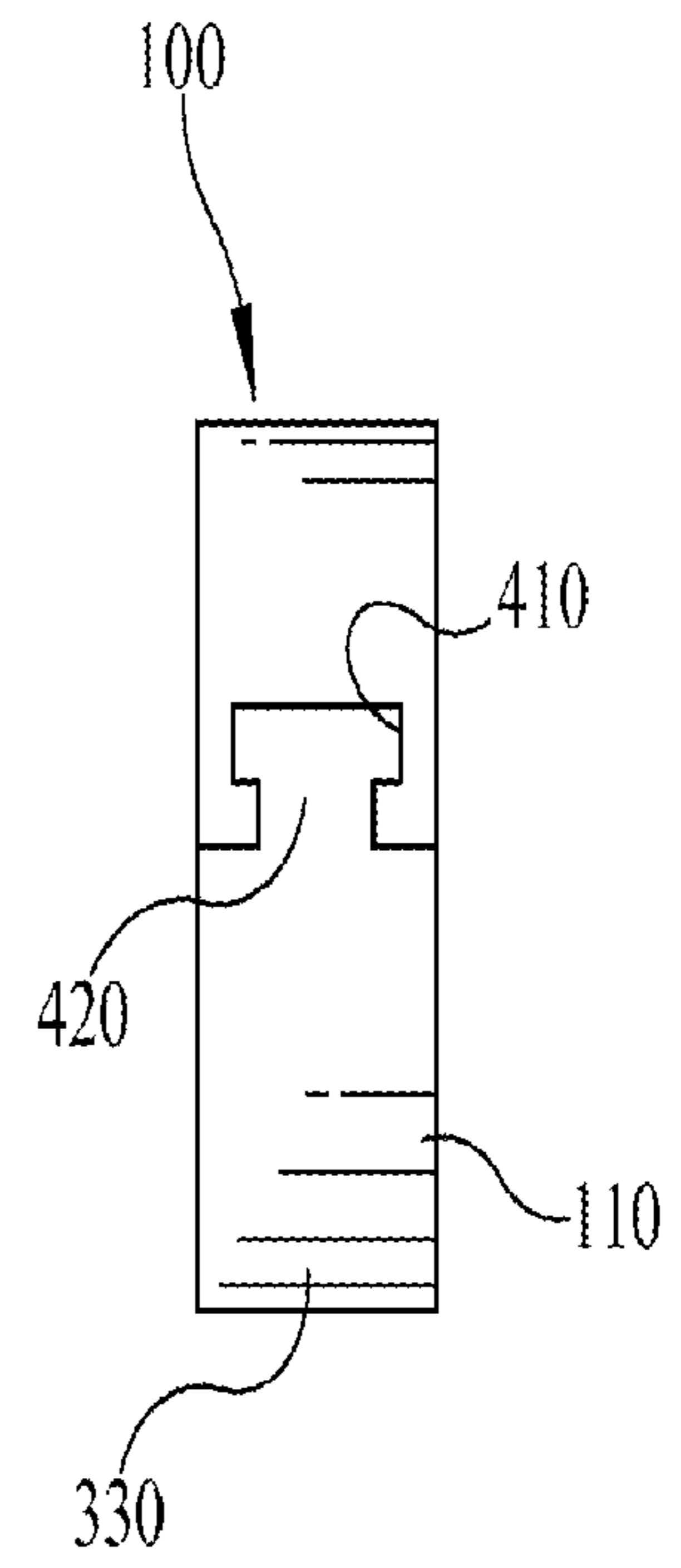
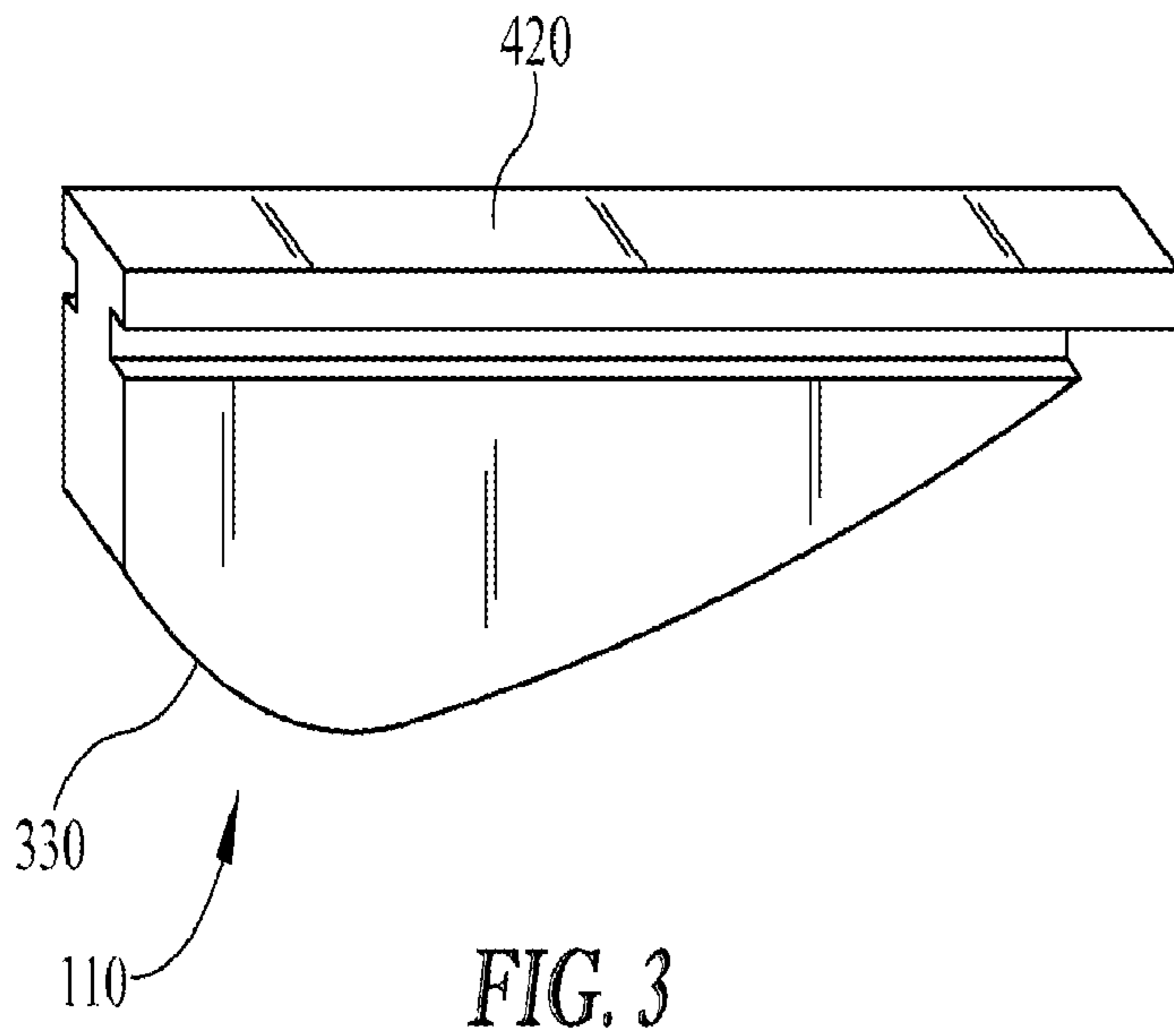
The present invention involves a seed firmer with a pusher attachment that extends the life of the seed firmer and improved brackets for mounting the same to a planter. The improved brackets allow for different mechanisms of mounting seed firmers to different locations on a planter. The brackets have portions for attaching and mounting to the planter, and a housing for accepting and securing the firmers. The brackets allow for better positioning of firmers on a planter, ease of mounting and/or replacement of firmers, and improved firmer functionality.

**12 Claims, 26 Drawing Sheets**









**FIG. 4**

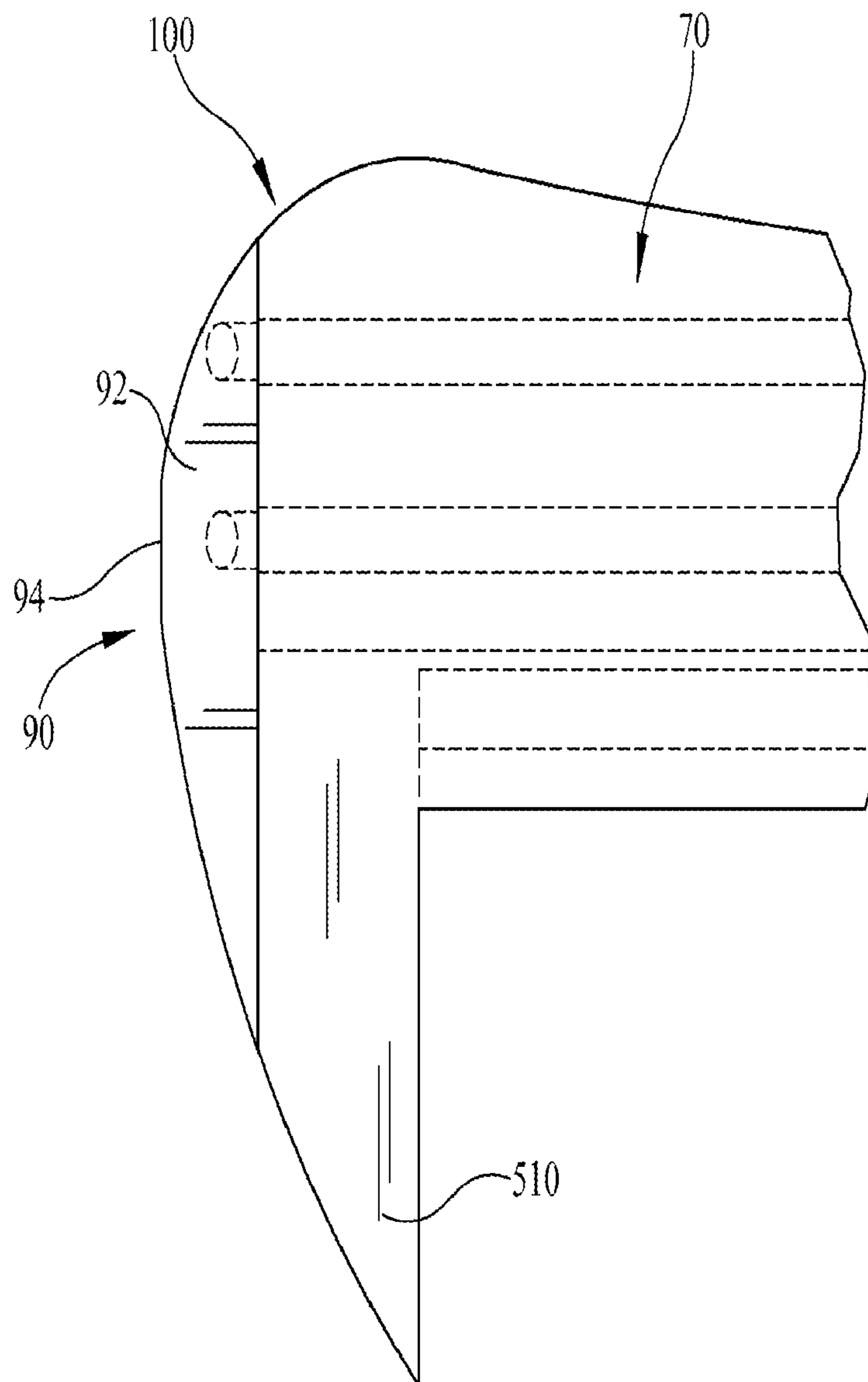


FIG. 5

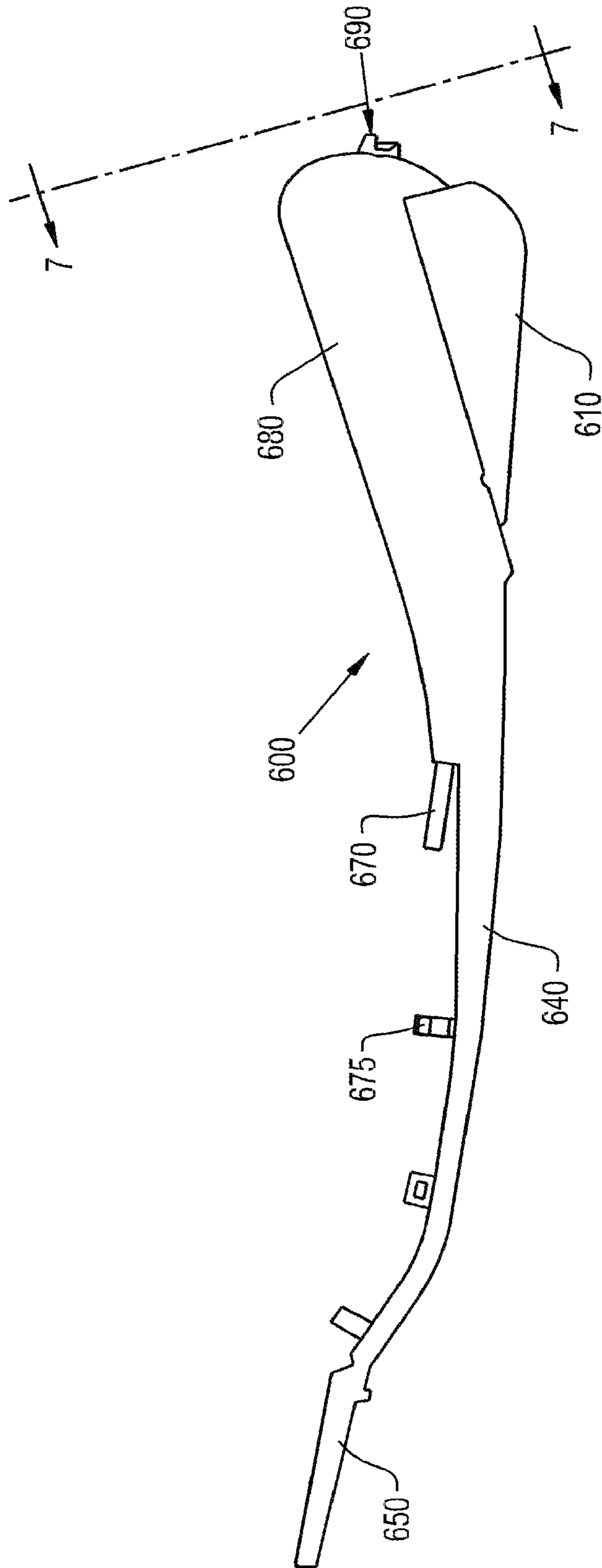


Fig. 6

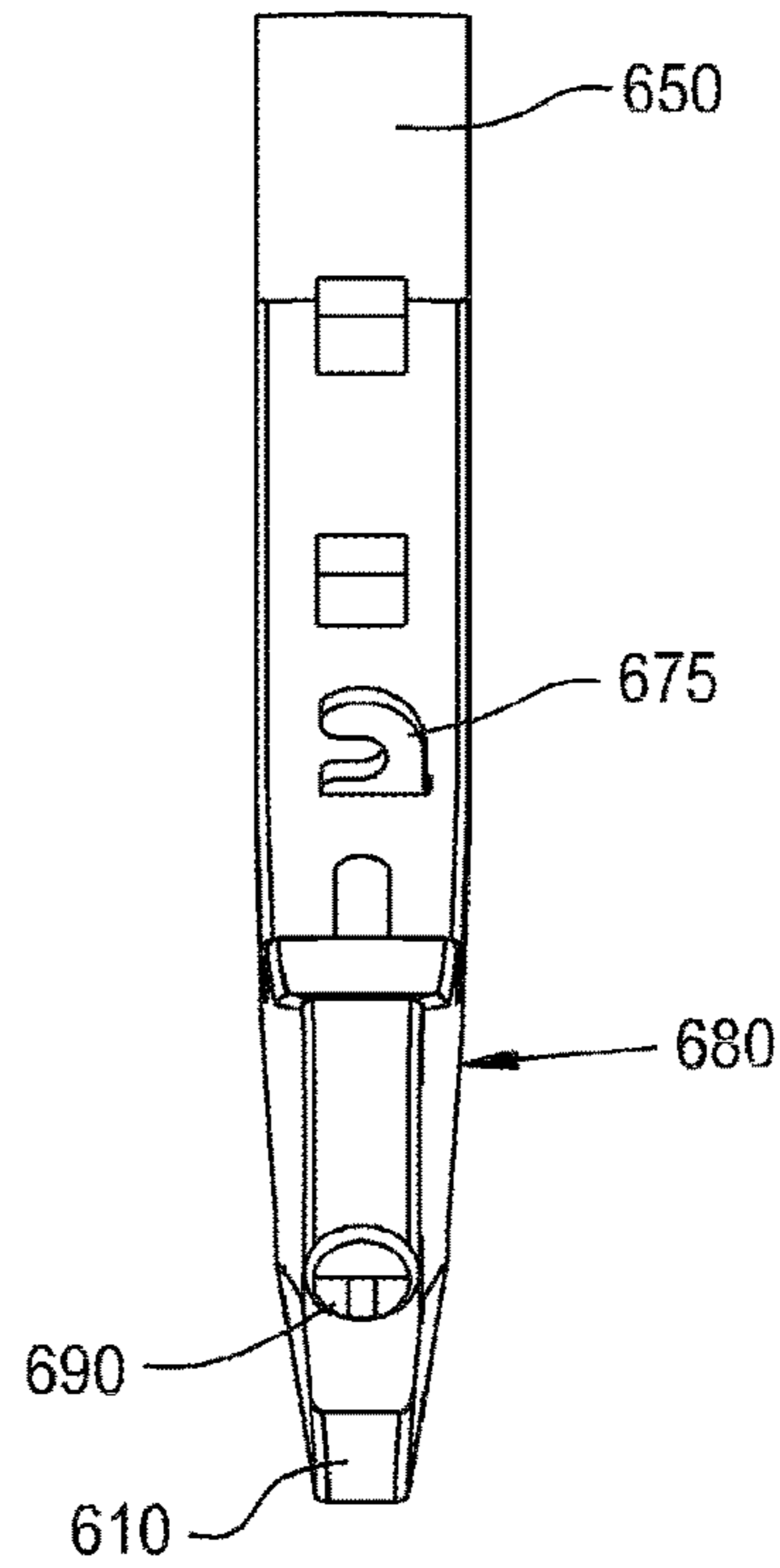


Fig. 7

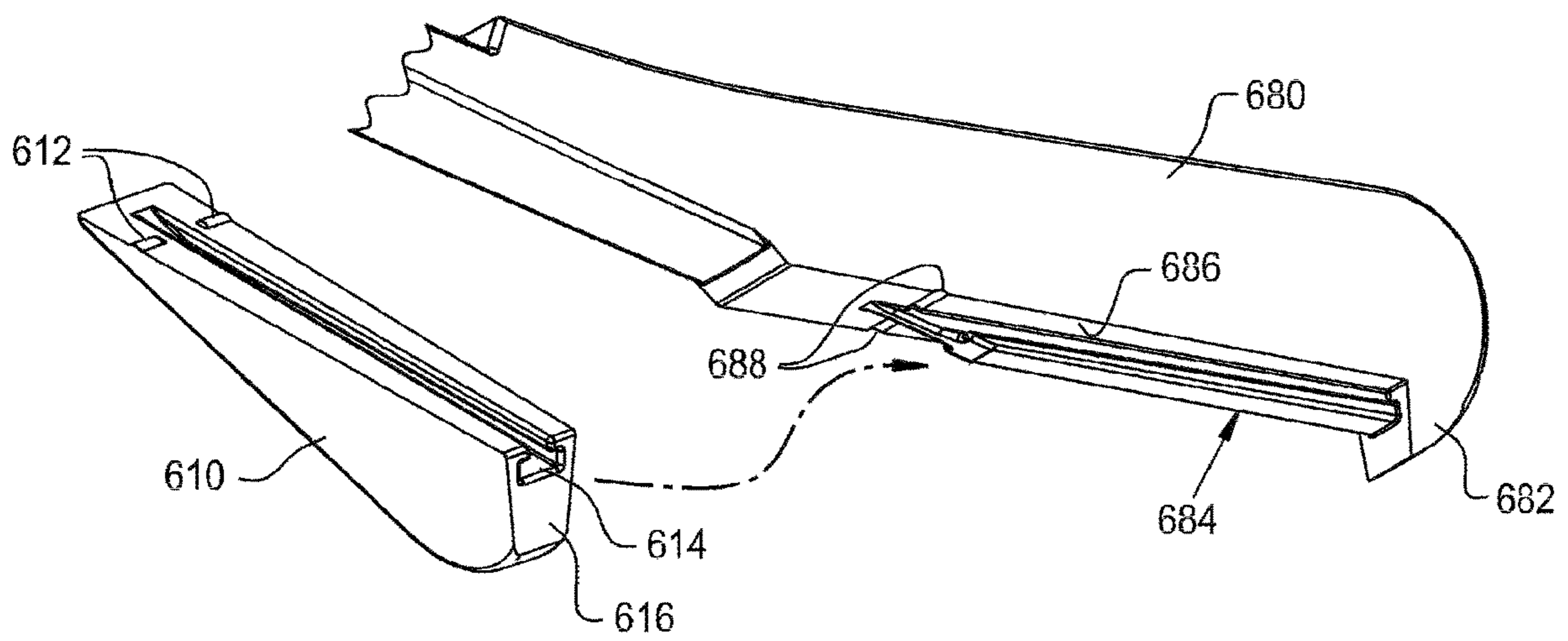
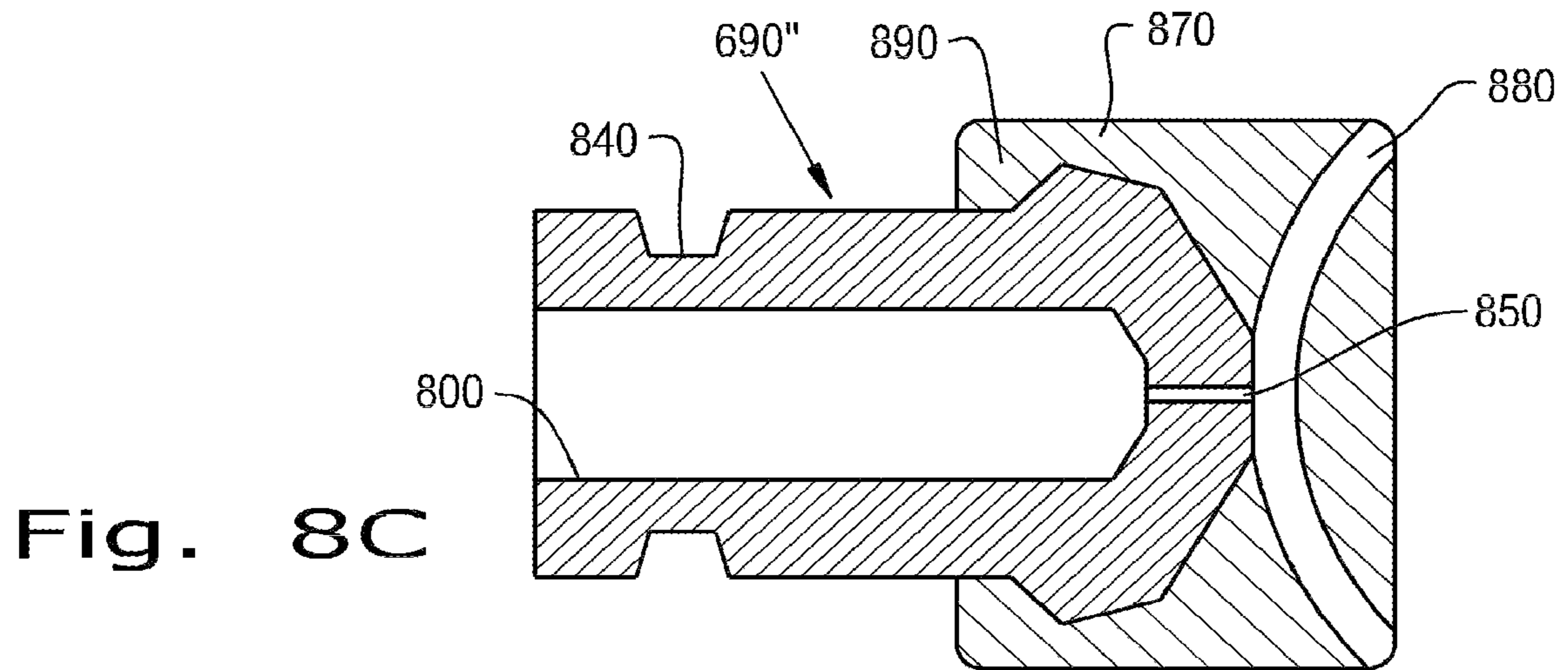
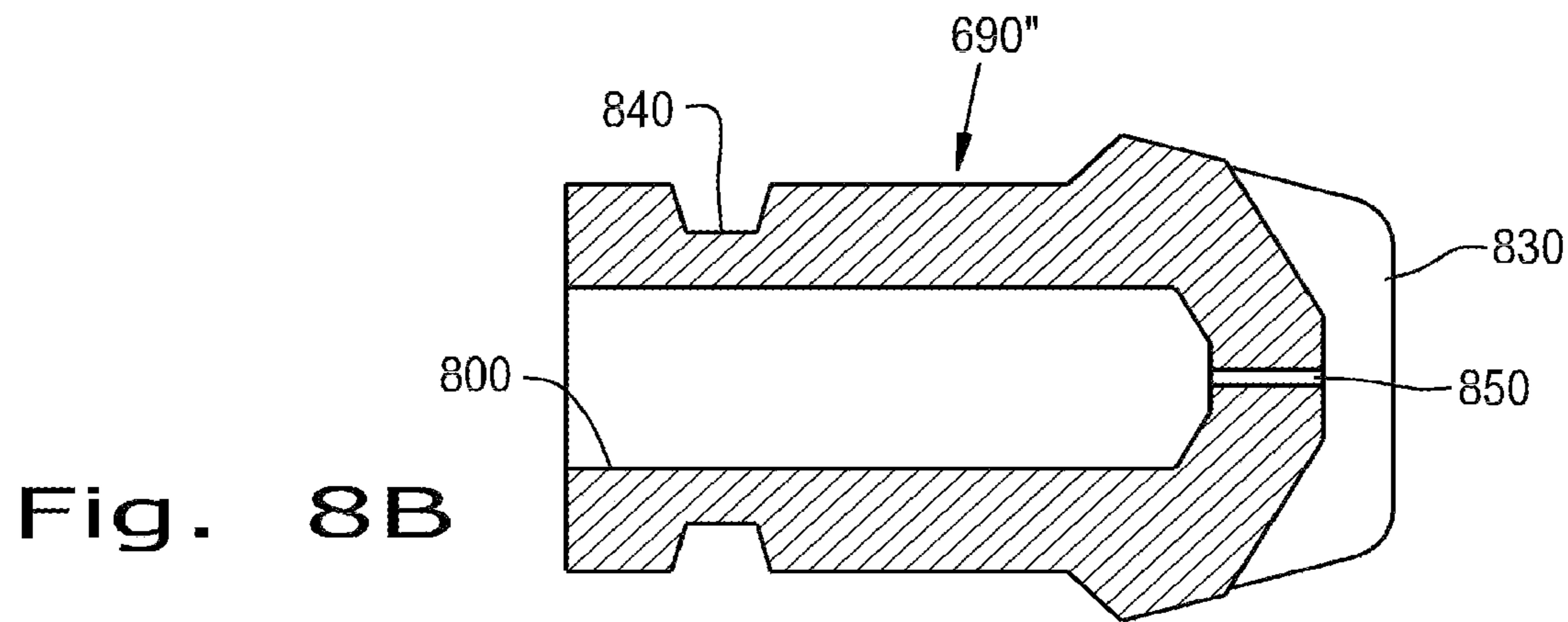
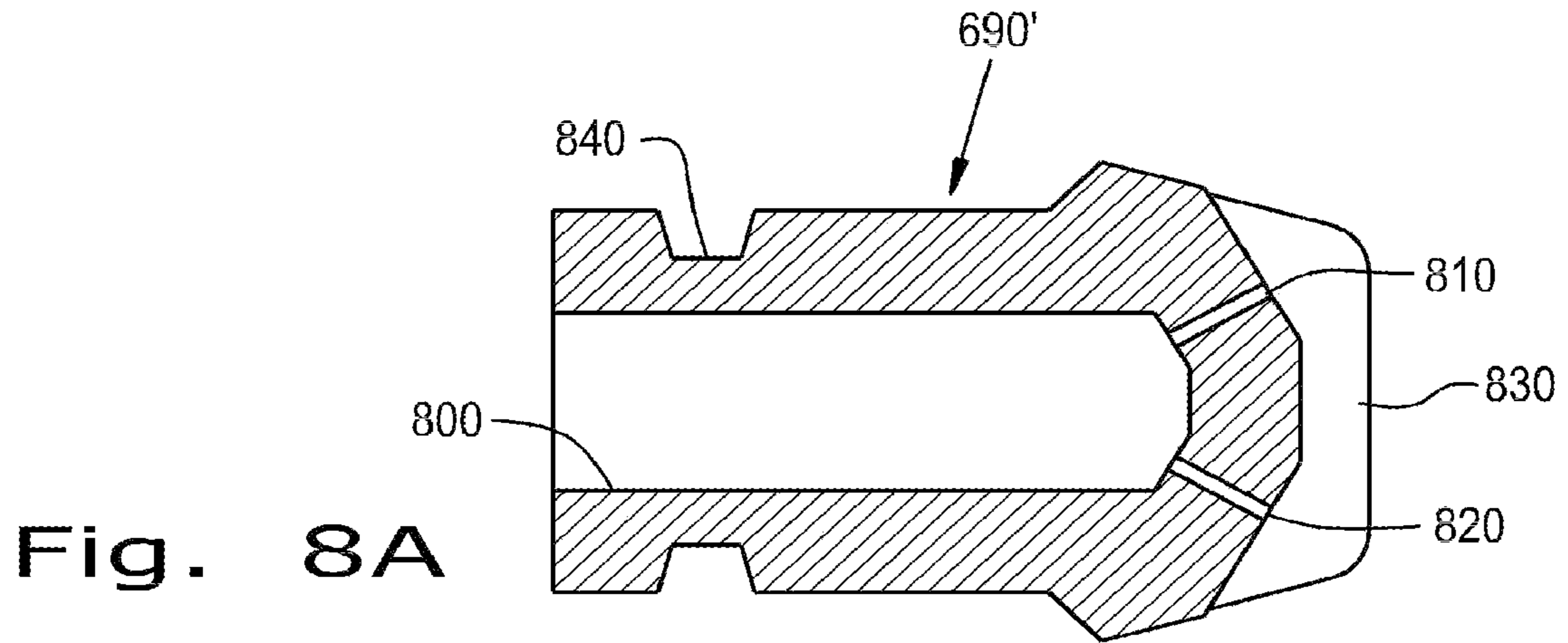


Fig. 9





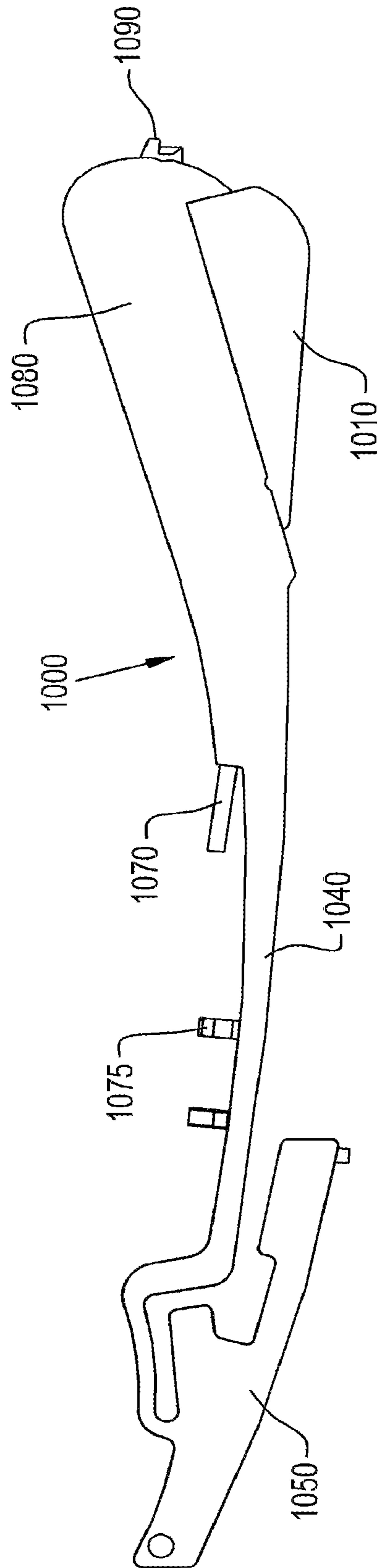


Fig. 10

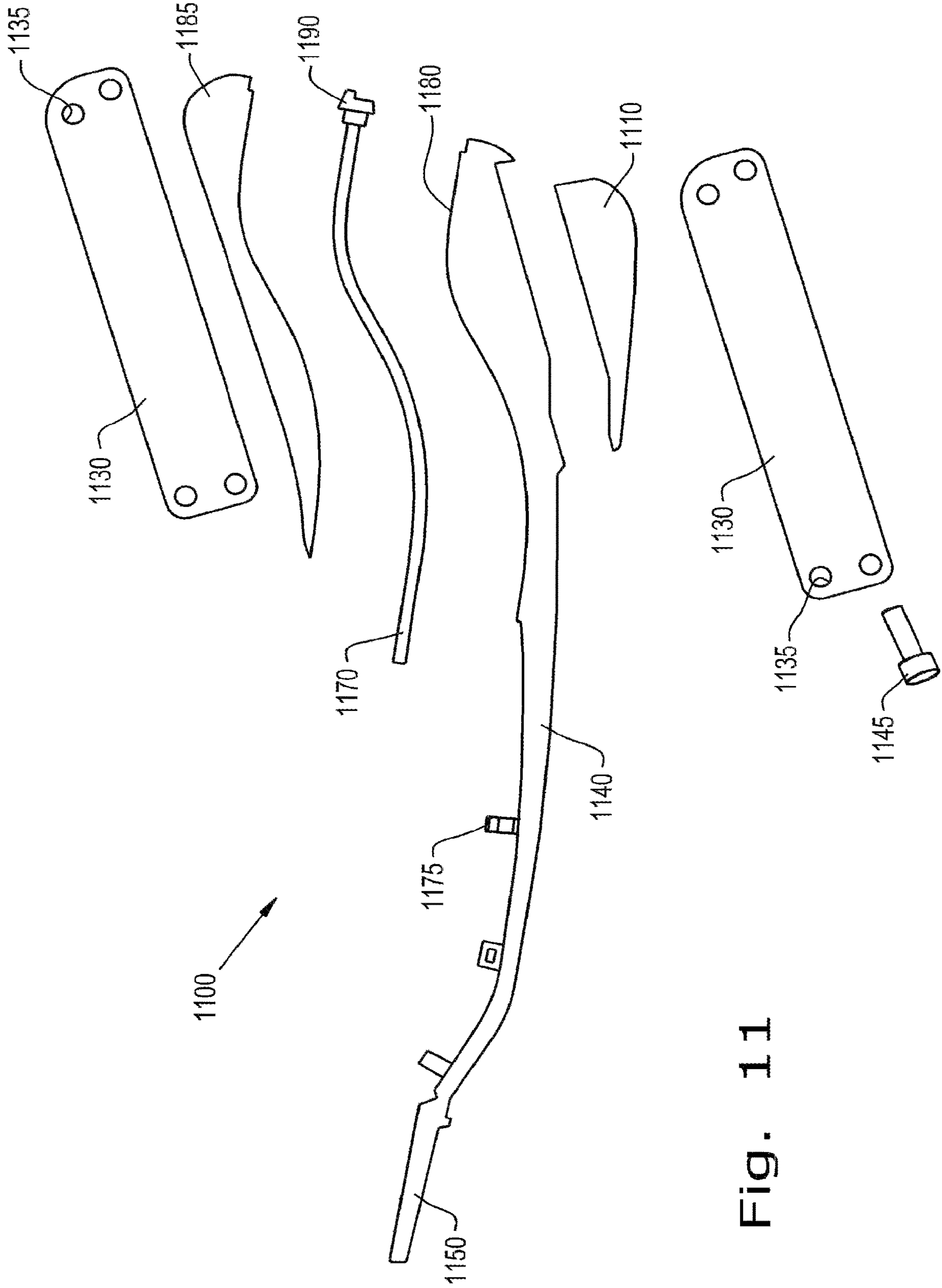


Fig. 11

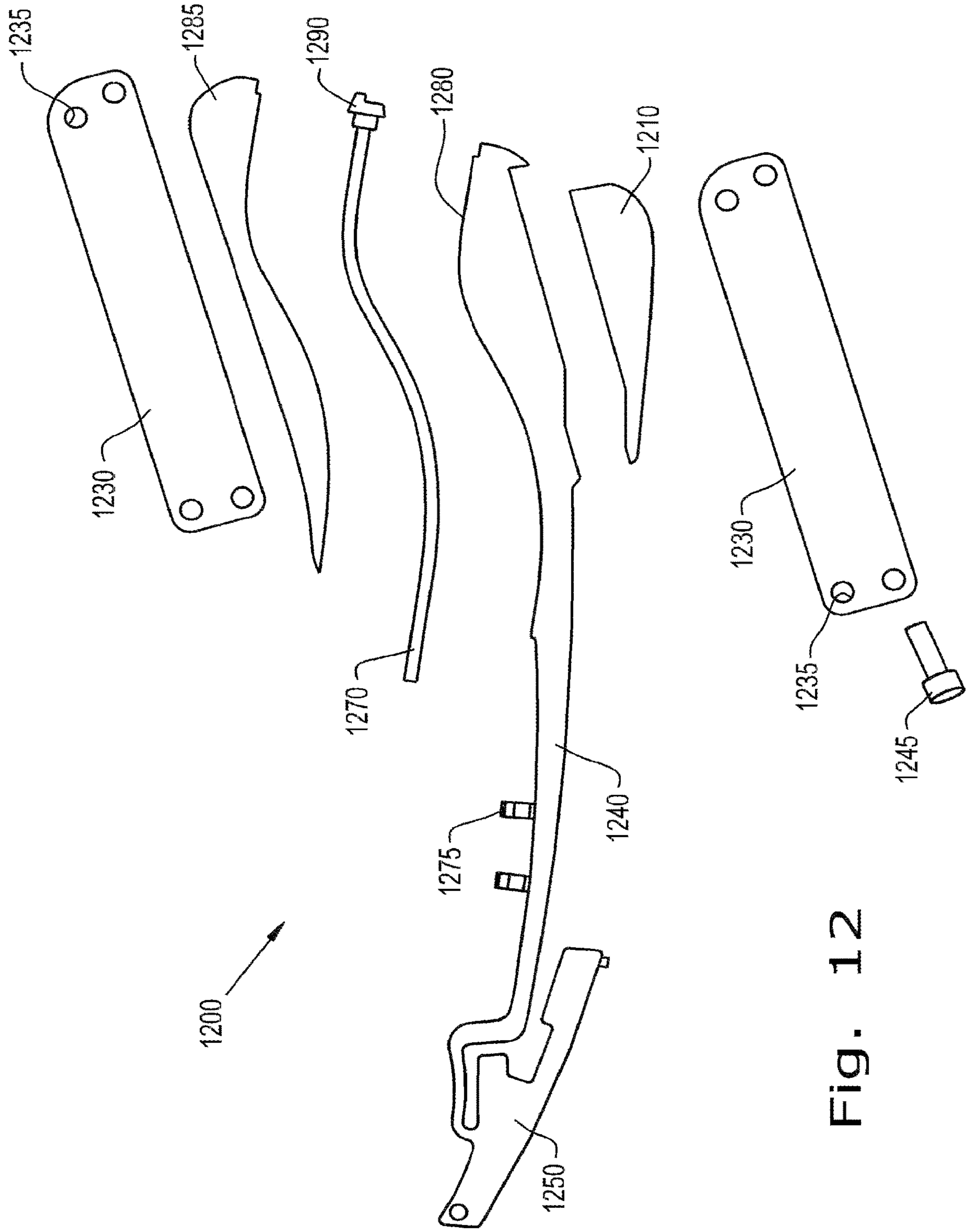


Fig. 12

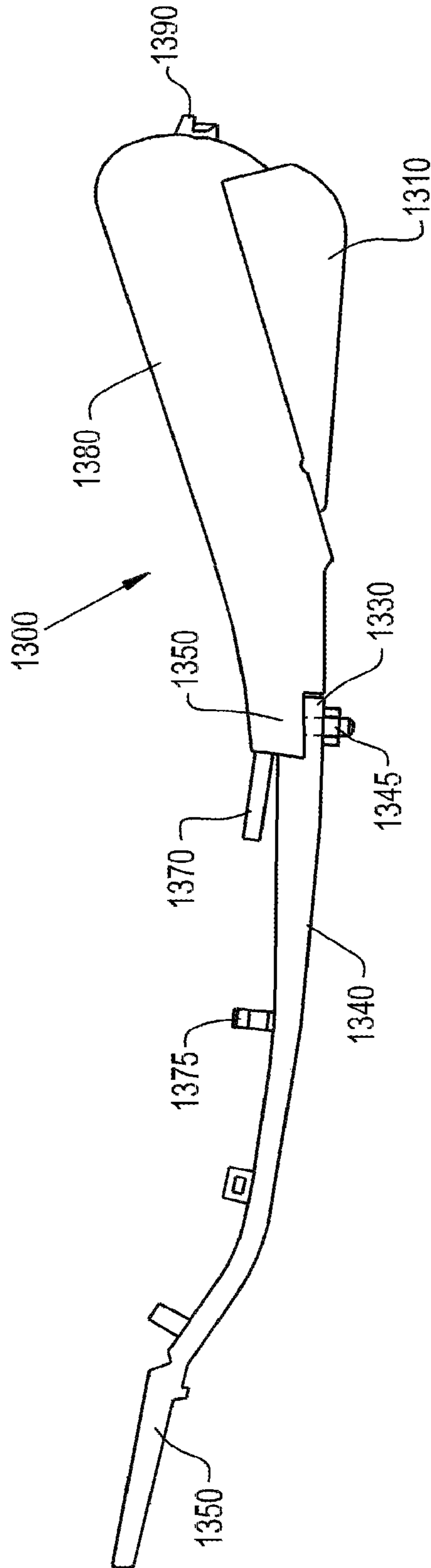


Fig. 13

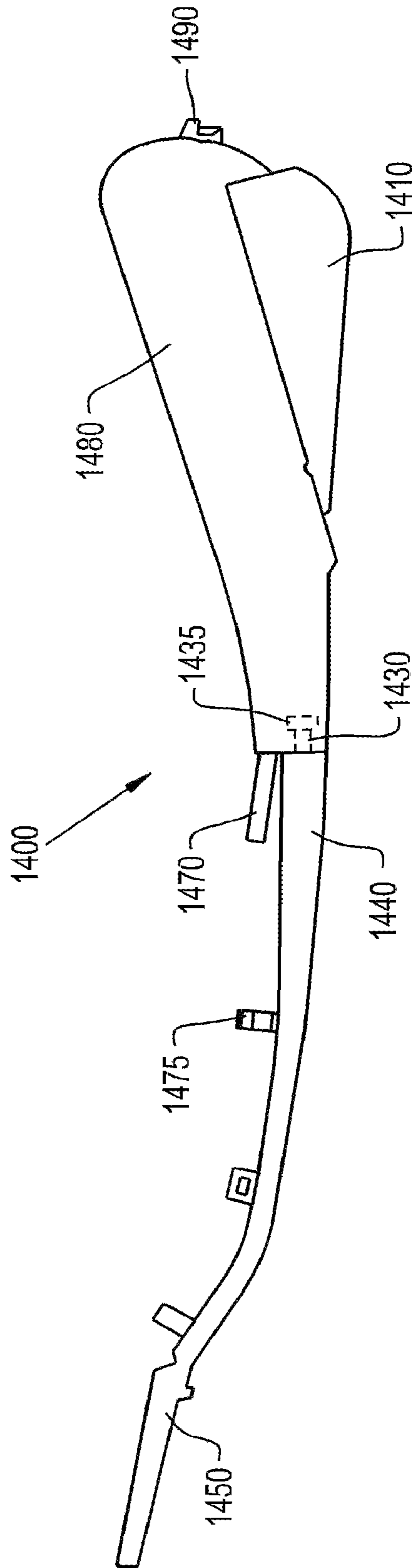


Fig. 14

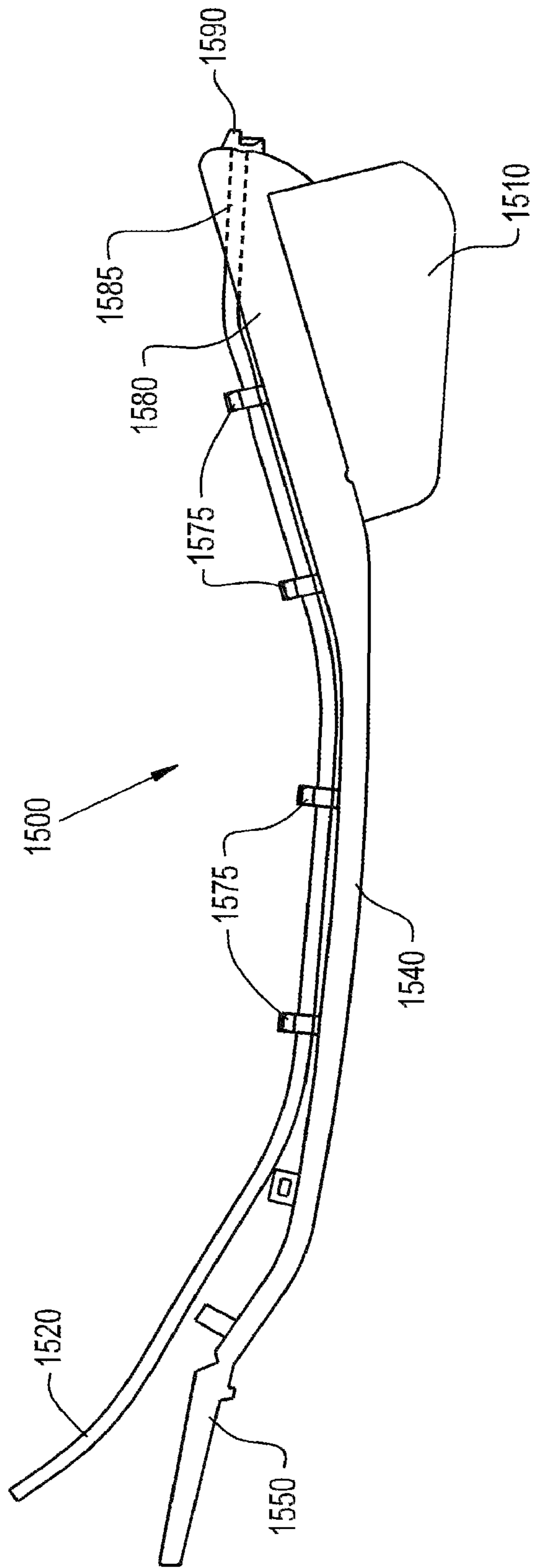
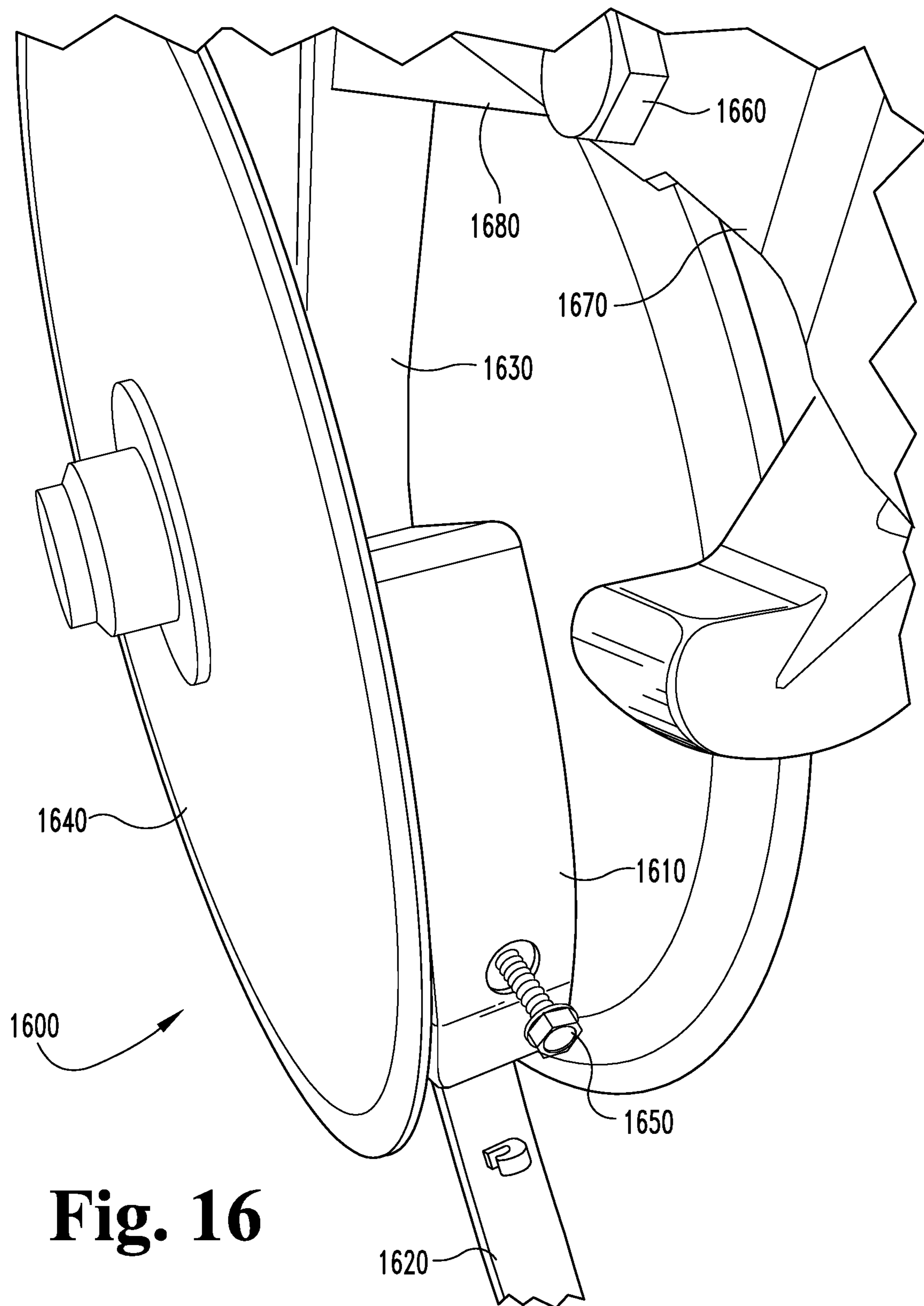


Fig. 15



**Fig. 16**

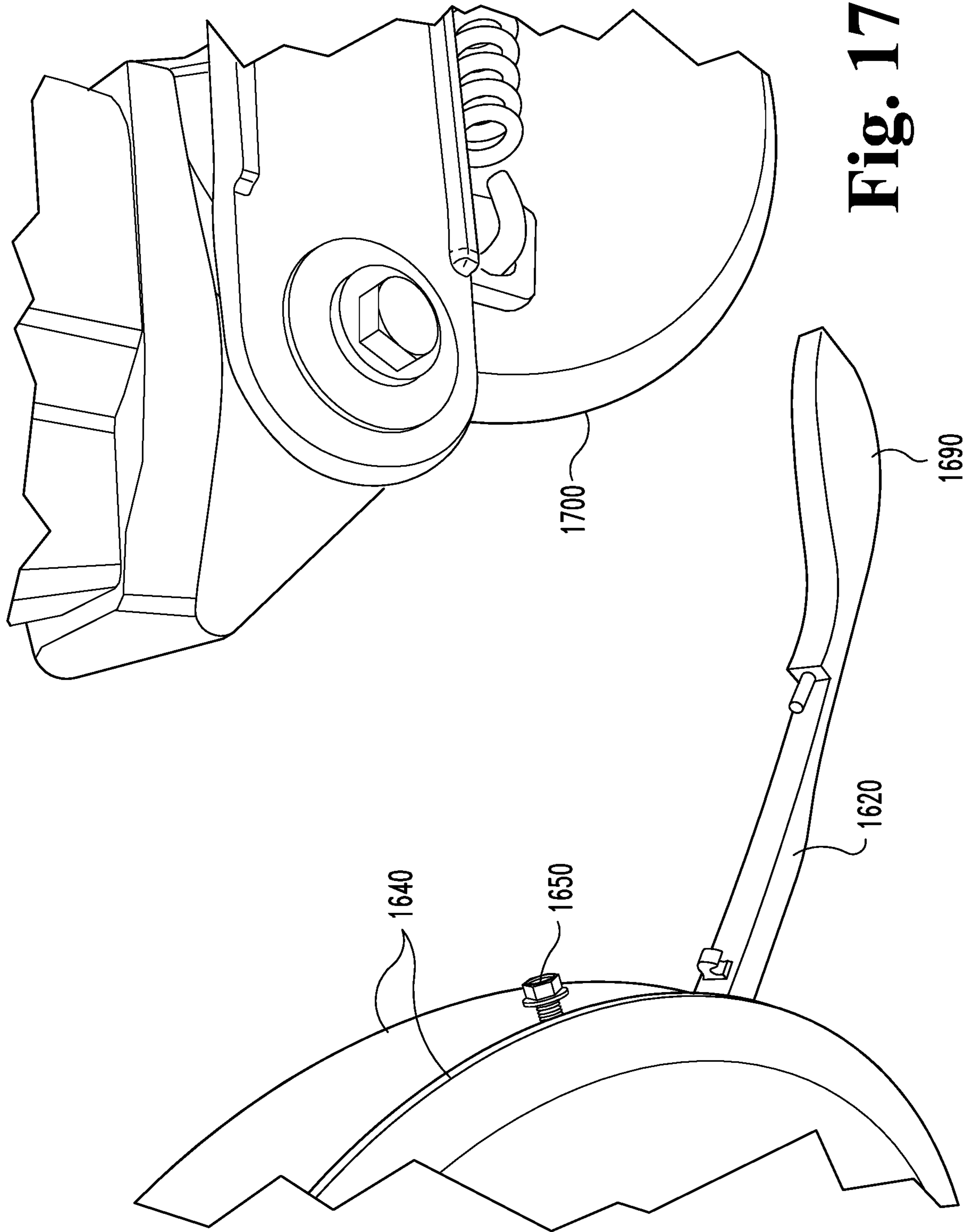
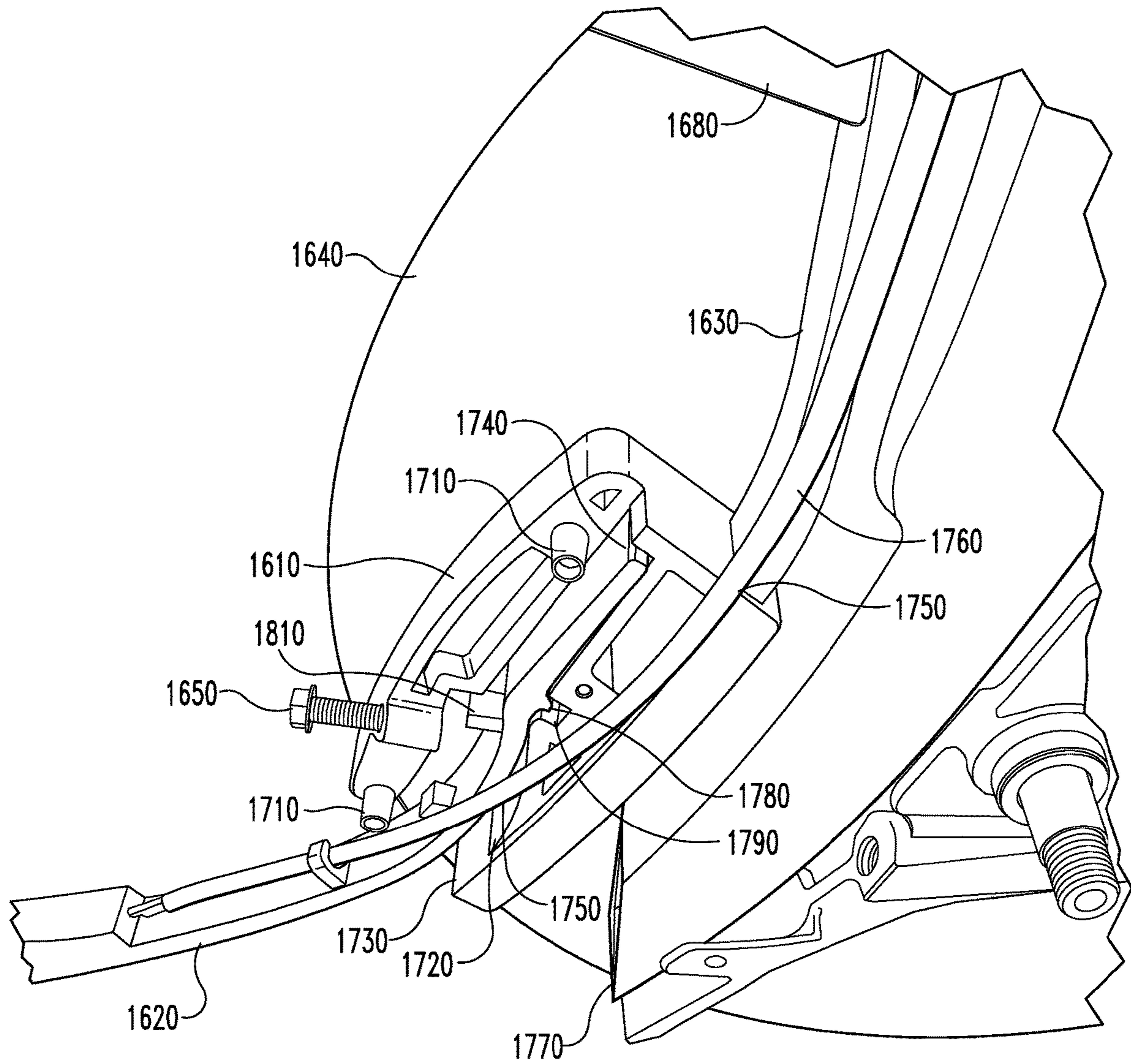
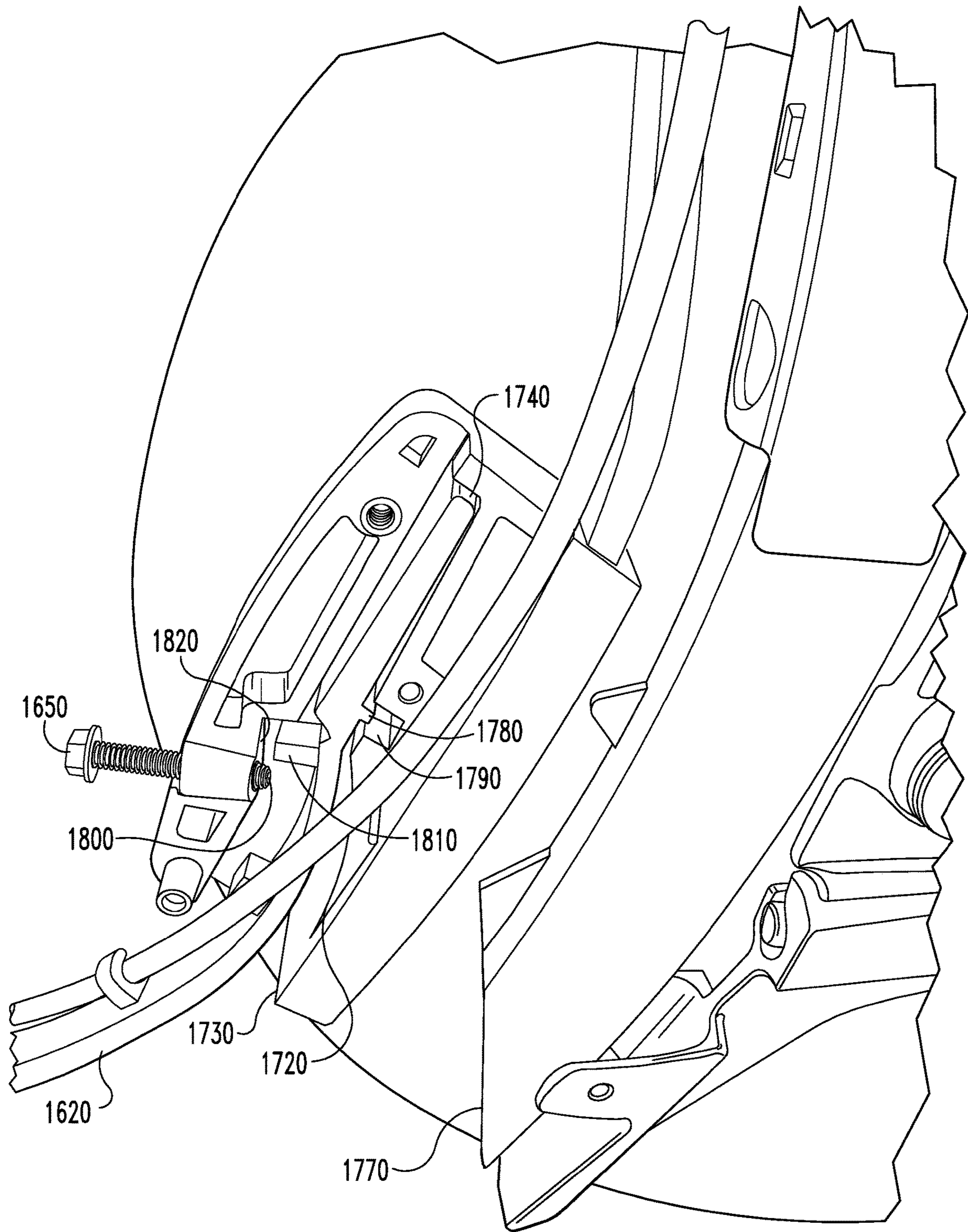


Fig. 17

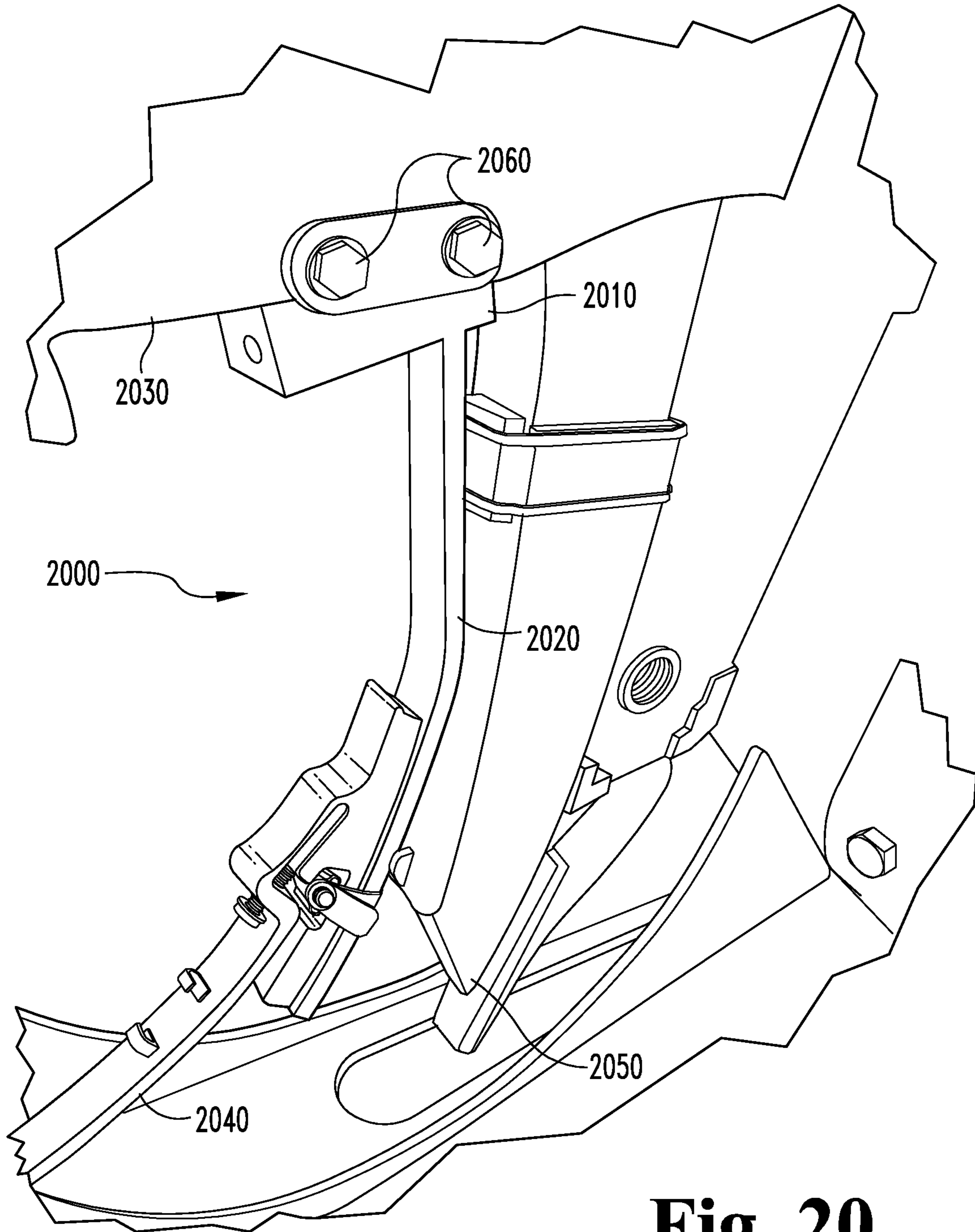




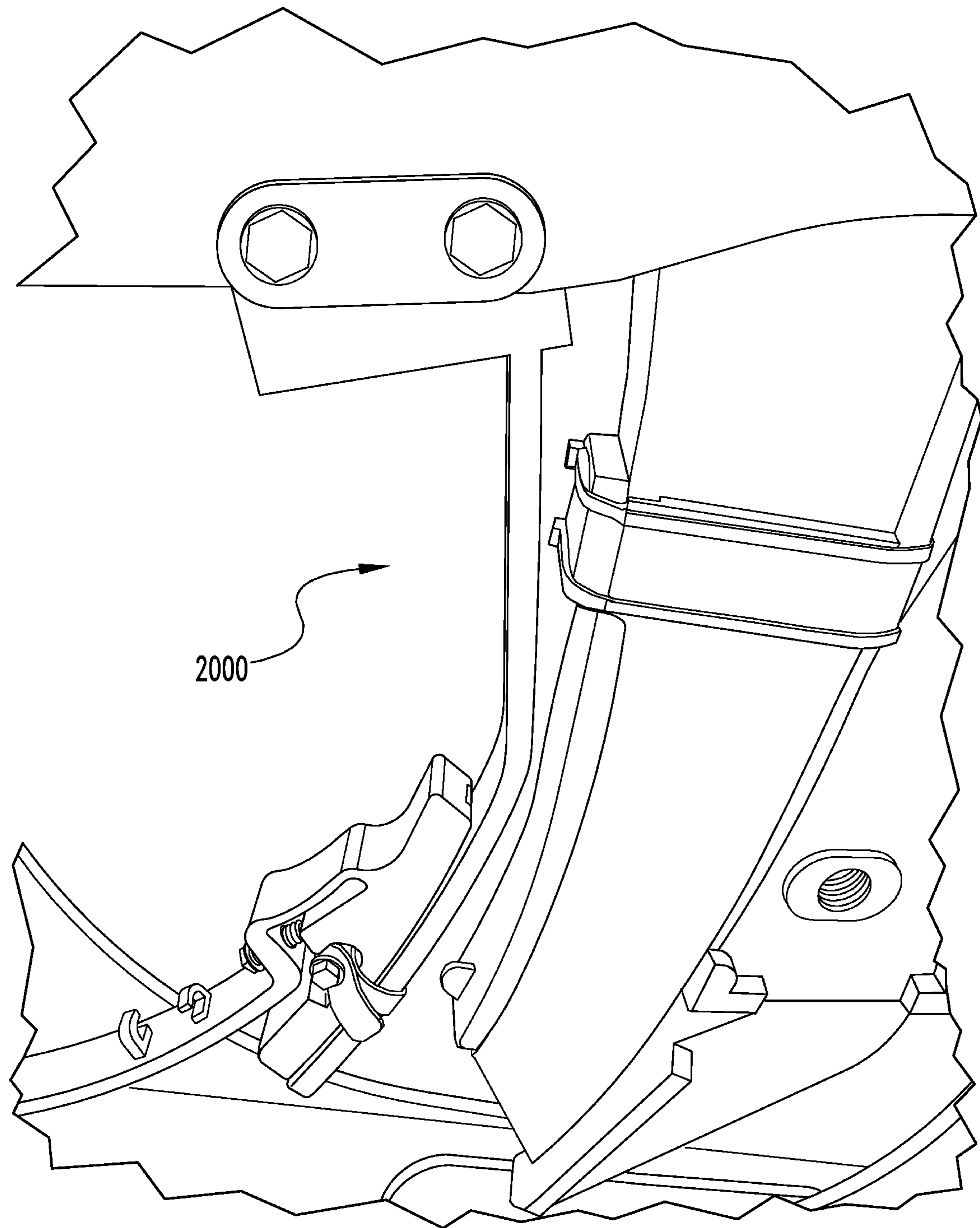
**Fig. 18**



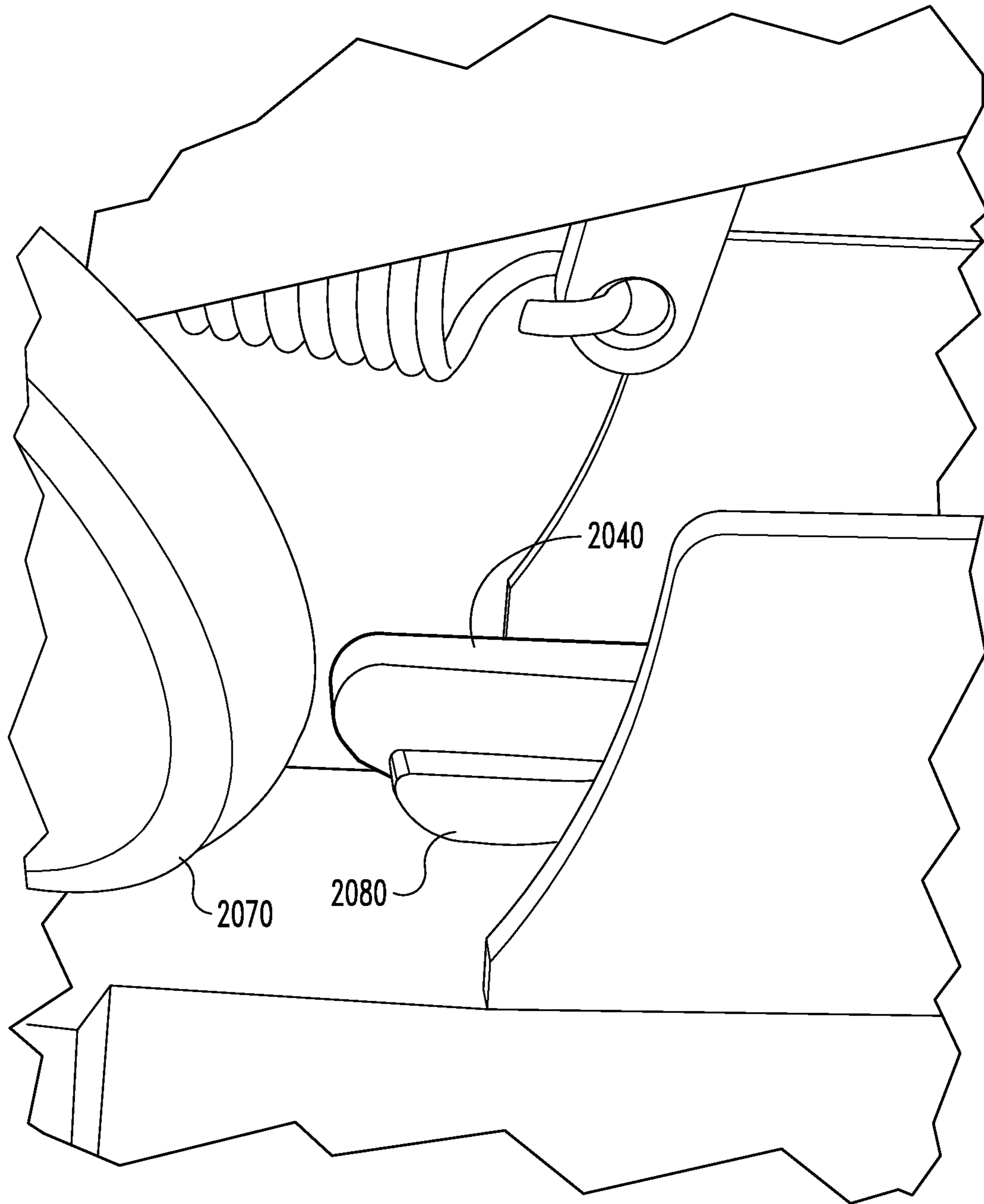
**Fig. 19**



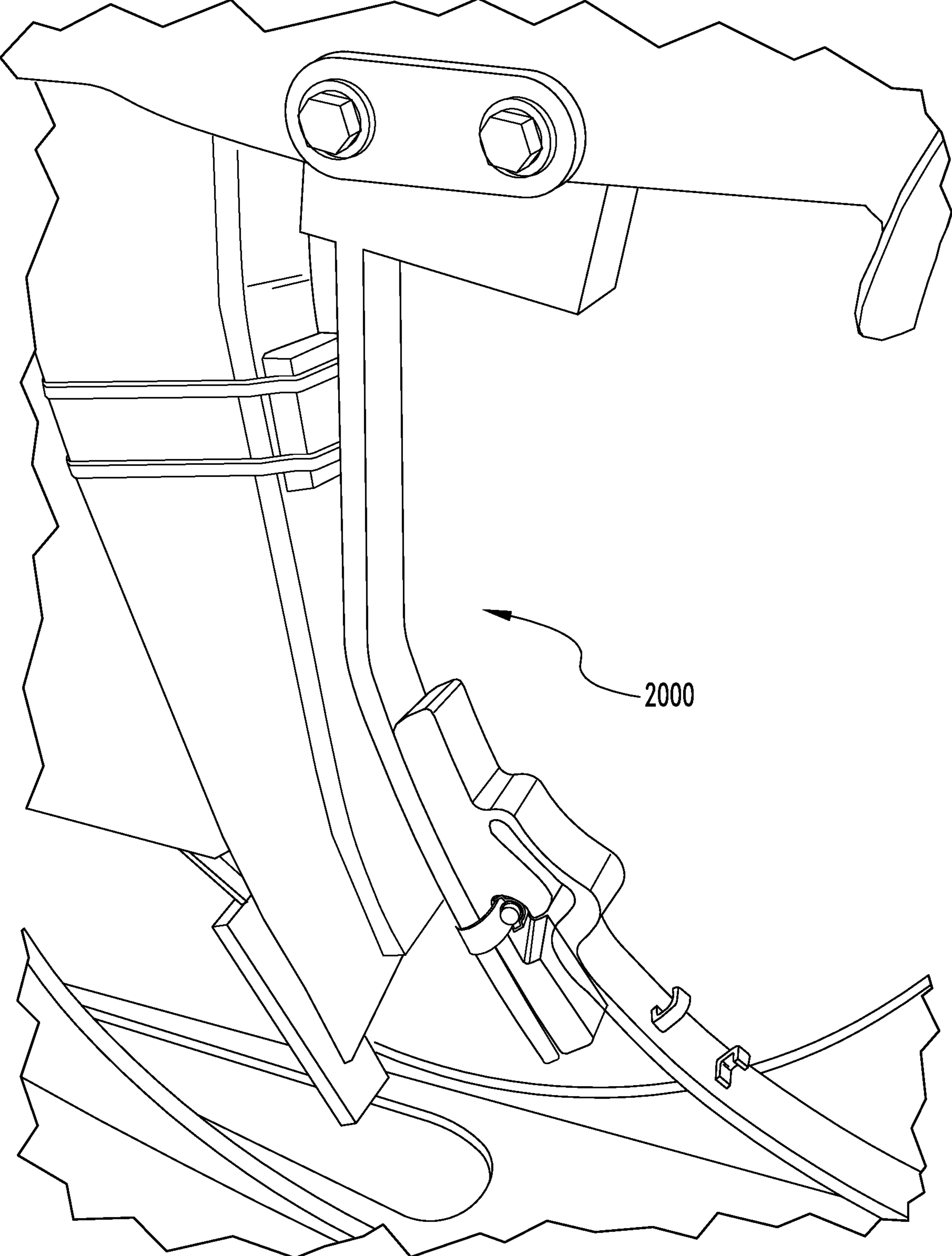
**Fig. 20**



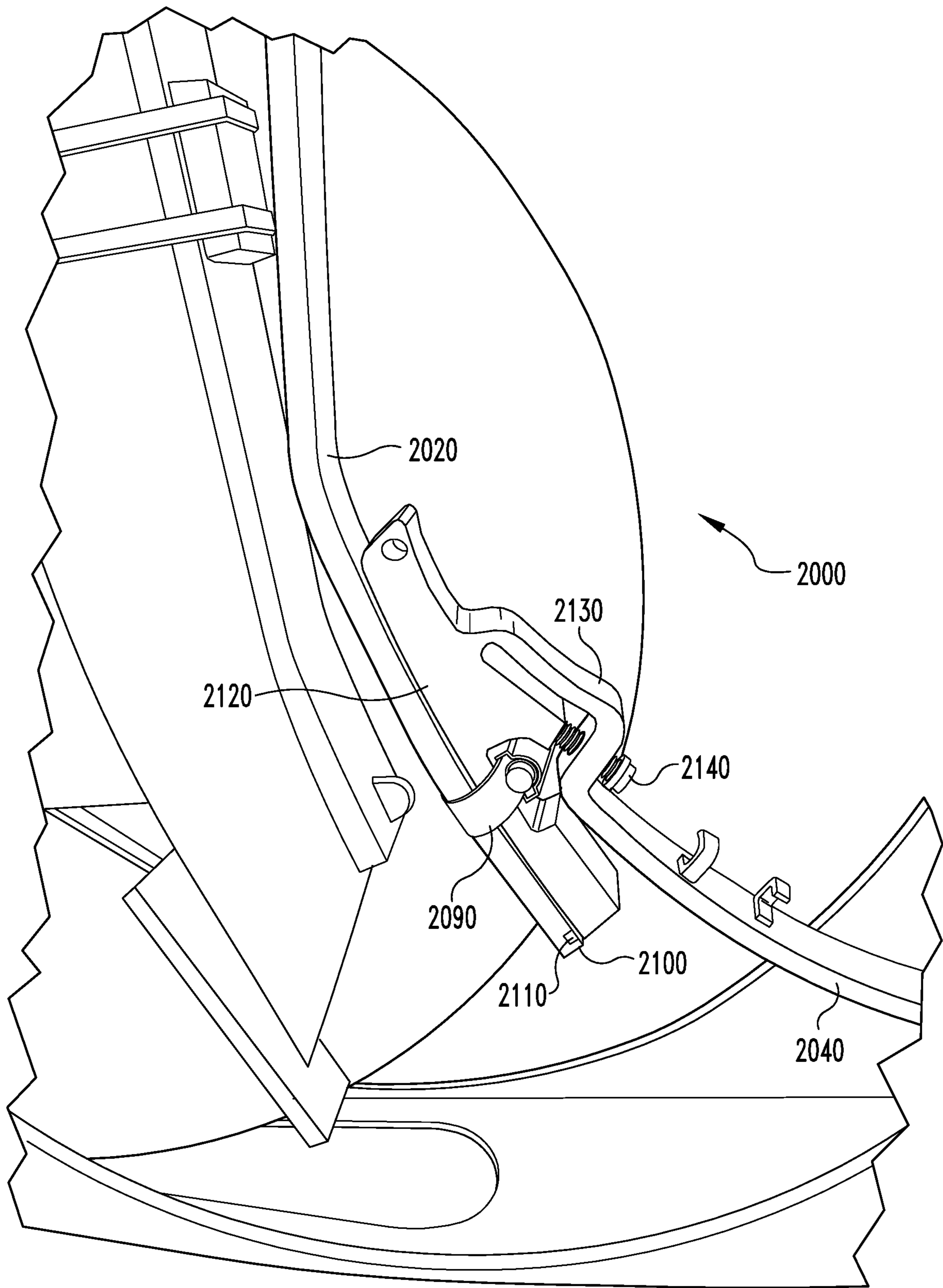
**Fig. 21**



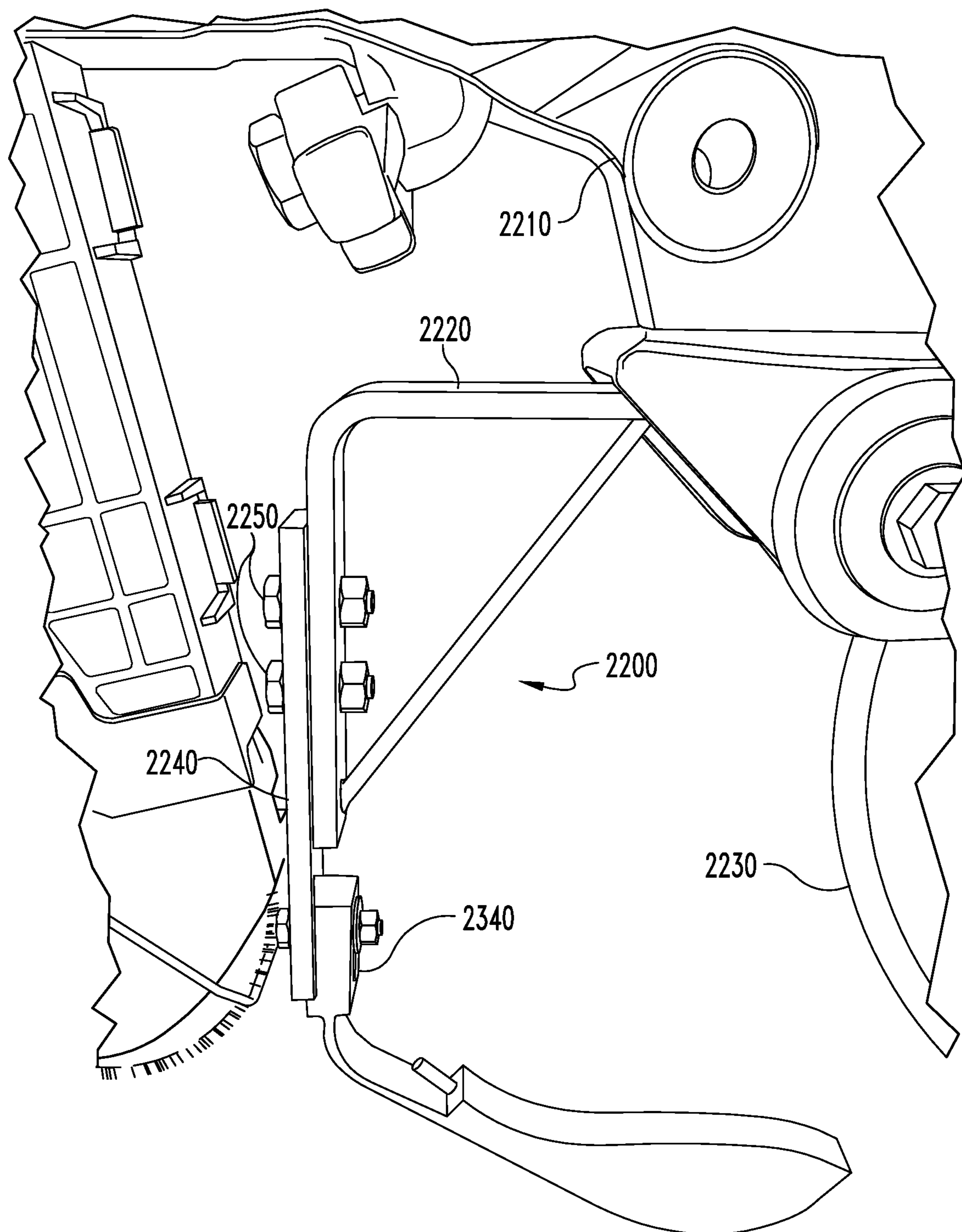
**Fig. 22**



**Fig. 23**

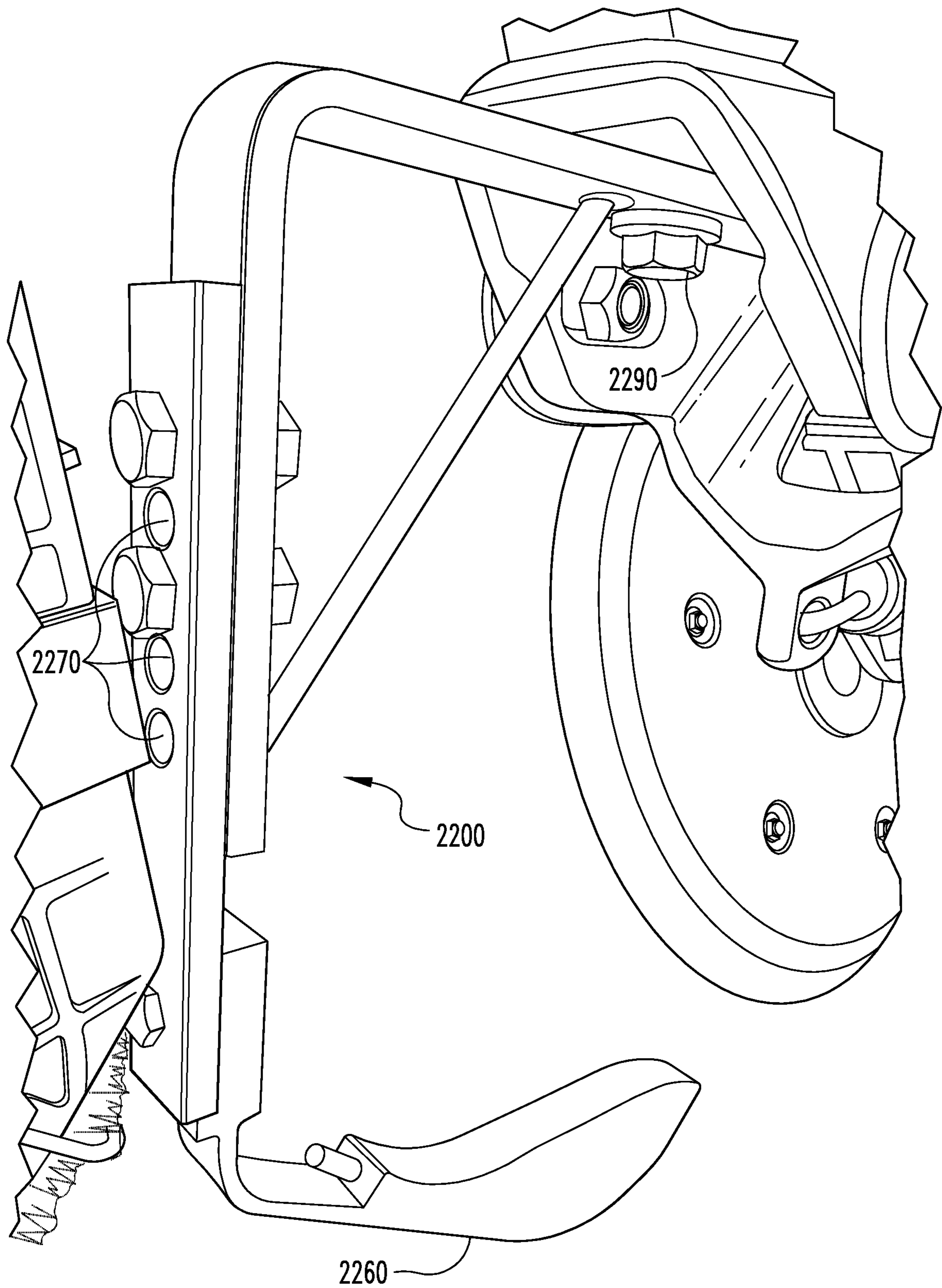


**Fig. 24**

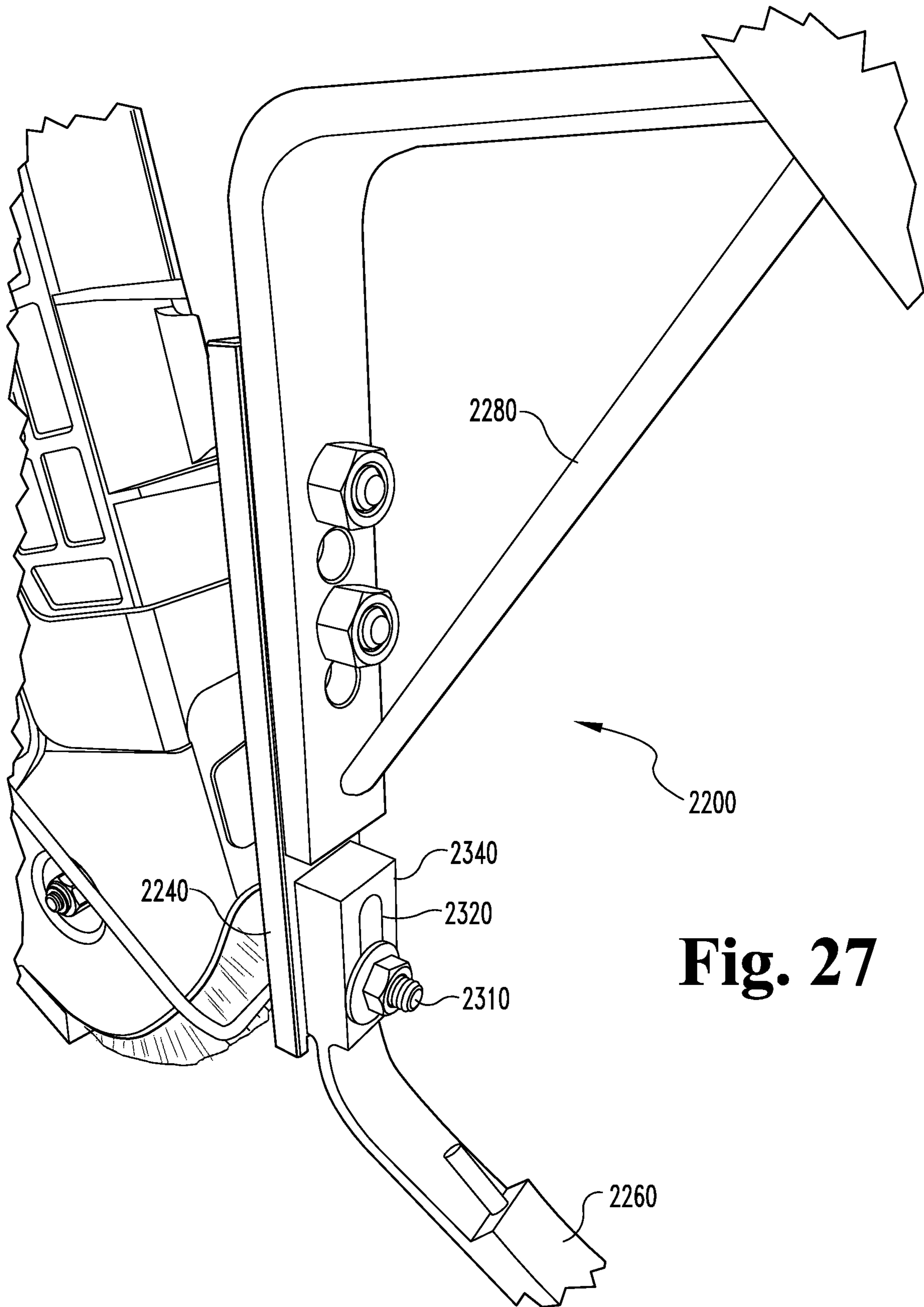


**Fig. 25**

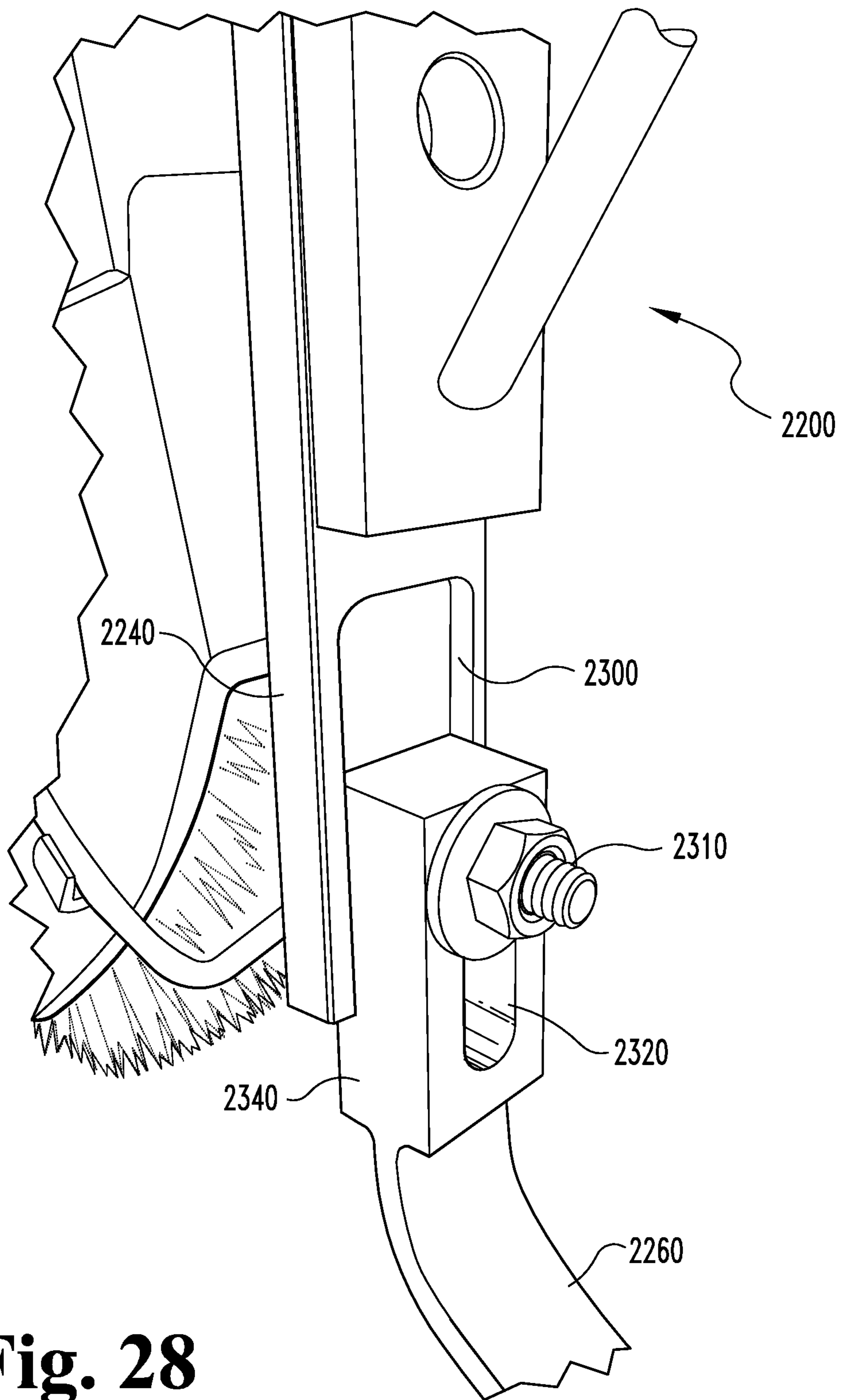




**Fig. 26**



**Fig. 27**



**Fig. 28**

## SEED FIRMER LIFE EXTENDER MOUNTING BRACKET

### CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority under 35 U.S.C. § 119(e) to U.S. Patent Provisional Application Ser. No. 62/278,081 filed Jan. 13, 2016; to U.S. Patent Provisional Application Ser. No. 62/312,221 filed Mar. 23, 2016; is a continuation-in-part of co-pending U.S. patent application Ser. No. 14/627,096, filed Feb. 20, 2015 which claims priority to U.S. Patent Provisional Application Ser. No. 61/942,225, filed Feb. 20, 2014, to U.S. Patent Provisional Application Ser. No. 62/018,173, filed Jun. 27, 2014, and is a continuation-in-part of co-pending U.S. patent application Ser. No. 14/012,246, filed Nov. 4, 2013, which is a continuation-in-part of U.S. patent application Ser. No. 13/862,698, filed Apr. 15, 2013 (abandoned), which claims priority to U.S. Patent Provisional Application Ser. No. 61/642,004 filed May 3, 2012; and to PCT/US2016/066214, filed Dec. 12, 2016, the disclosures of which are incorporated by reference herein.

### BACKGROUND

#### Field of the Invention

The invention relates to agricultural planting implements. More specifically, the field of the invention is that of seed firmers and brackets for mounting them to planters.

#### Description of the Related Art

Seed firmers are known and used extensively in agricultural planting systems. Such firmers add to the expense of a planting implement but are thought to more than pay for themselves in terms of increased yield. U.S. Pat. No. 5,425,318 describes one type of seed firmer; U.S. Pat. Nos. 5,730,074, 5,852,982, 6,082,274, and 6,220,191 describe seed firmers having liquid dispensing arrangements; and U.S. Pat. No. 7,497,174 describes a mounting system for seed firmers. Complicated mounting systems and bracket devices are used to mount the firmers on planters for use during the planting season, typically attached to the seed chute. Improvements in the cost and performance of the firmer and mounting systems are always welcomed.

### SUMMARY

The present invention involves a seed firmer construction which provides a replaceable tip or end for extending the life of the firmer, and a bracket for mounting the seed firmer. The seed firmer generally has two components that degrade with use, the flexible arm and the embedding pusher. The flexible arm generally lasts much longer than the embedding pusher portion because the pusher wears against the ground and eventually wear away. Embodiments of the invention include an embedding pusher portion that has a stop and a guide for accepting a replaceable extender. Other embodiments include an embedding pusher portion that engages the rest of the firmer arm. Thus, the portion of the firmer that wears down may be easily replaced which extends the life of the firmer, multiple times over the useful life of the flexible arm. The mounting bracket is for attaching the seed firmer to a planter with a mounting portion adapted to mount the bracket to an existing attachment point on a planter tool arm.

The mounting bracket also has a housing portion adapted to receive the flexible portion of a seed firmer, with an opening for receiving the flexible portion of the seed firmer and a slot for receiving a protrusion on the flexible portion of the seed firmer. The seed firmer is secured to the bracket when the firmer protrusion is engaged with the housing slot such that the mounting portion is positioned on the planter tool arm to allow the firming portion of the firmer to be disposed aft of the planter seed chute and forward of the planter closing wheels.

In one embodiment, the end of the firmer has a slot that is bounded by a stop portion. The embedding pusher attachment slides into the slot and abuts the stop portion. The bottom of the embedding pusher operates in a conventional manner pushing the seed downwardly into the ground to thus embed the seed in the soil. During the usable life of the firmer, the flexible portion may operate on several embedding pusher attachments. In another embodiment, the embedding end is attached to the flexible arm, with the pusher attachment detachably extending from the embedding arm. In further embodiment, the arm of the attachment portion of the firmer has a connecting portion that attaches to a replaceable embedding element.

The embodiments of the firmer of the present invention optionally provide a passageway for fluid to be dispensed proximate the end of the firmer. The end of the passageway includes a directional attachment that directs fluid in relation to the end of the firmer. Other embodiments attach to the planting system either by connection to the seed tube, or connection to a mounting bracket on the planter. A further embodiment includes a delivery tube deployed within the walls of the embedding portion, with the end cap of the tube providing alternative passageways for the dispensing of liquid.

In one embodiment, the embedding arm has a width that expands from the width of about a seed at the bottom to double or triple width at the top. This narrowing of the embedding arm provides sufficient structure to support the constant interaction with the soil as the firmer is pulled through rows of plants. The thicker portion of the embedding arm provides sufficient width for the optional liquid delivery pipe or tube.

Many embodiments include an aperture at the end proximate where the seed is embedded. In one embodiment, a plug is used at that end. The plug may include an overhang to protect the hole from accumulation of debris. In one embodiment, the plug may be drilled to create either a straight backward stream of exiting liquid, while in another embodiment the plug may have two or more holes to create several distinct streams of exiting liquid. Another embodiment has a single plug with a through bore for creating the straight backward stream of exiting liquid, with an additional cap with one or more holes that create other angled streams. The cap may be snap fit or otherwise attached over the plug.

The extender portion of the firmer may attach to the pusher portion of the firmer via a variety of physical and mechanical couplings. For example, a peg in hole coupling, a glue based coupling, and a sonic welded coupling are all possible implementations of the invention. In several embodiments, a tongue and groove arrangement is used to couple the extender and the pusher portions. In one embodiment, the extender has a T shaped projection on the surface interfacing with the pusher portion which has a corresponding T-shaped groove to accept the projection and couple the two pieces together. This allows the extender to slide into the groove until abutting the stop. In one further embodiment,

the surfaces having the tongue and groove include a further mating bump and depression, arranged so that the engagement of the bump and depression deter further relative movement of the extender and pusher portions. Thus, in several embodiments, the extender may be slid into the groove and snap fit at a precise location.

While the extender is disposed on one end of the firmer, the flexible or pushing portion is disposed at the other end and is adapted to be mounted to the planter in alignment with the seed chute. In one embodiment, the mounting portion of the pushing portion has elements that interfit and complement elements on the seed chute so that the pusher portion is directly aligned with the seed chute. In another embodiment, the pushing portion has a flat mounting end that is configured for engagement with a mounting device for holding a flat flange.

Liquid delivery is provided by a tube and discharge path formed in the firmer. In one embodiment, the solid firmer has a passageway shaped to receive a pipe, in one embodiment a curved pipe. Once the firmer is first molded, the curved pipe is inserted while the firmer material is setting up. One end of the pipe is attached to a tube, typically a plastic tube, to receive liquid (e.g., water, fertilizer, herbicides, and/or insecticides) from a source. In one embodiment, that first end of the pipe has ridges or is gnarled or otherwise roughened to enhance the connection of the tube. The other side of the pipe faces a discharge area of the firmer. An internal channel leads to a discharge passage. In one embodiment, a central discharge passage is straight back of the firmer. In another embodiment, multiple passages are present to direct liquid discharge at an angle to the body of the firmer. In yet another embodiment, a cap may be placed over the central discharge passage to redirect the discharging liquid in various angles.

Other embodiments of the invention include a firmer defined by a pair of sidewalls. The sidewalls hold the liquid tube proximate the end of the firmer, and attach to the mounting end of the firmer. The extender is detachably connected to the sidewalls, and may thus be replaced when sufficiently worn without having to replace the other portions of the firmer.

In yet another embodiment, the mounting portion of the firmer includes the pushing arm, and the end of the pushing arm attaches to the extender/embedding portion of the firmer. The optional liquid pipe may be included in the extender/embedding portion, or may be optionally coupled to the extender/embedding portion.

The present invention, in one form, relates to a seed firmer having a flexible portion and an embedding pusher portion. The flexible portion biases the embedding pusher portion into the soil. The embedding pusher portion includes a slot for receiving an embedding pusher attachment, the stop bounded at the end by a stop portion which retains the embedding pusher attachment as it is drawn over the soil.

In other embodiments the present invention relates to mounting brackets usable to mount firmers such as those previously described to planters. In one such embodiment a mounting bracket includes a mounting portion designed and configured to secure the bracket to an existing mounting point on a planter tool arm using existing bolts or other hardware. The bracket also includes a firmer securing housing configured to allow insertion of a portion of a firmer therein and capable of securing the firmer to the bracket. The firmer is secured when a protrusion on the firmer engages a corresponding notch or slot in the firmer housing. The firmer

may be removed by deforming or flexing the firmer until the protrusion is disengaged from the notch or slot and the firmer may be withdrawn.

In another embodiment, a mounting bracket is secured to a desired location on a planter tool arm using newly created mounting points and/or mounting hardware. The bracket includes a firmer securing housing configured to allow insertion of a portion of a firmer therein and capable of securing the firmer to the bracket. The firmer is secured when a protrusion on the firmer engages a corresponding notch or slot in the firmer housing. The firmer may be removed by deforming or flexing the firmer until the protrusion is disengaged from the notch or slot and the firmer may be withdrawn.

In still another embodiment, a mounting bracket includes a firmer mounting portion having a slotted portion sized and adapted to receive a portion of the firmer. The firmer is then bolted or otherwise secured to the mounting bracket where the slotted portion prevents the firmer from twisting out of alignment while in use. Depth of the firmer in a furrow may be adjusted by positioning the firmer within the slotted portion at the desired depth.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The above mentioned and other features and objects of this invention, and the manner of attaining them, will become more apparent and the invention itself will be better understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a side view of a first embodiment of the firmer of the present invention shown in use.

FIG. 2 is a sectional view of FIG. 1 showing a through channel.

FIG. 3 is a perspective view of the first embodiment of the extender of the present invention.

FIG. 4 is a side sectional view of the firmer of the first embodiment of the present invention showing the interconnection of the extender and firmer body.

FIG. 5 is a perspective view of an end portion of the first embodiment of the present invention.

FIG. 6 is a perspective view of a second embodiment of the present invention.

FIG. 7 is an enlarged view of the liquid dispensing end of the second embodiment of the present invention.

FIGS. 8A, 8B, and 8C are cross-sectional views of three embodiments of a liquid dispensing plug according to the present invention.

FIG. 9 is an enlarged view of the interconnection of the extender and the firmer body of the second embodiment of the present invention.

FIG. 10 is a perspective view of a third embodiment of the present invention.

FIG. 11 is an exploded view of a fourth embodiment of the present invention.

FIG. 12 is an exploded view of a fifth embodiment of the present invention.

FIG. 13 is a side view of a sixth embodiment of the present invention.

FIG. 14 is a side view of a seventh embodiment of the present invention.

FIG. 15 is a side view of an eighth embodiment of the present invention.

FIG. 16 is a perspective view of a mounting bracket according to one embodiment of the present invention.

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FIG. 17 is another perspective view of the mounting bracket shown in FIG. 16.

FIG. 18 is a side view of the mounting bracket shown in FIG. 16.

FIG. 19 is another side view of the mounting bracket shown in FIG. 16.

FIG. 20 is a perspective view of a mounting bracket according to another embodiment of the present invention.

FIG. 21 is a side view of the mounting bracket shown in FIG. 20.

FIG. 22 is a side view of a firmer attached to the mounting bracket shown in FIG. 20.

FIG. 23 is a perspective view of the mounting bracket shown in FIG. 20.

FIG. 24 is another perspective view of the mounting bracket shown in FIG. 20.

FIG. 25 is a side view of a mounting bracket according to still another embodiment of the present invention.

FIG. 26 is a perspective view of the mounting bracket shown in FIG. 25.

FIG. 27 is another perspective view of the mounting bracket shown in FIG. 25.

FIG. 28 is a close up perspective view of the mounting bracket shown in FIG. 25.

Corresponding reference characters indicate corresponding parts throughout the several views. Although the drawings represent embodiments of the present invention, the drawings are not necessarily to scale and certain features may be exaggerated in order to better illustrate and explain the present invention. The exemplification set out herein illustrates embodiments of the invention, in several forms, and such exemplifications are not to be construed as limiting the scope of the invention in any manner.

## DESCRIPTION

The embodiments disclosed below are not intended to be exhaustive or limit the invention to the precise forms disclosed in the following detailed description. Rather, the embodiments are chosen and described so that others skilled in the art may utilize their teachings.

FIG. 1 shows seed firmer 100 disposed in operation, having embedding pusher portion, or extender, 110 positioned relative to seed chute 10 in a conventional manner. Seed chute 10 is positioned relative to disc 40 by mount 30 so that chute 10 delivers seeds 50 to trough 60, with extender portion 110 being so positioned to embed seeds 50 into the soil of trough 60. Firmer 100 includes interior channel 70 which extends from nipples 80 to end point 90, and is sized to receive tube 20, which in this exemplary embodiment involves conventional liquid tubes that deliver herbicides, fertilizers, pesticides, and/or mixtures of those chemicals to deposit on or near seed 50 once embedded.

Firmer 100 has an attachment portion, extender 110, that is located at a position on firmer 100 that contacts and embeds seeds 50 into the soil defining trough 60. In one embodiment, extender 110 fits into slot 410 in firmer 100 (see FIG. 4), with slot 410 bounded by hard stop portion 510 (see FIG. 5) that retains extender 110 against the direction of movement of firmer 100 over the soil. In this embodiment, extender 110 has tongue 420 having a "T" shape that slideably engages slot 410 so that when not in use, extender 110 may be easily replaced. When firmer 100 is in use, the force subjected to extender 110 urges it into hard stop 510. The exact shape and arrangement of the slideable engagement of slot 410 and tongue 420 may have several varia-

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tions, for example a circular or arc shaped tongue and slot, or a tongue and slot with several angles.

Extender 110 (see FIG. 3) may be made of conventional materials so that seeds 50 are pressed by the conventional surface and the material wears similarly to conventional firmers. However, once embedding surface 330 wears away so as to diminish the capacity of firmer 100, extender 110 may be replaced. Replacement is made without removing firmer 100 from mount 30. Instead, a farmer may simply slide the old one of extender 110 and slide in a new one. Hard stop 510 limits the range of motion of extender 110, and when firmer 100 is drawn across trough 60 then extender 110 is pressed into hard stop 510.

Firmer 100 also has an elongated interior channel 70 which is structured and arranged to receive tube 72, which in the disclosed embodiment is a convention liquid delivery tube, for delivering liquid on or near an embedded one of seeds 50 (see FIGS. 2 and 5). An open end of interior channel 70 is configured to receive nipple 80, which serves as a fluid connection between supply tube 20 and interior tube 72. Interior tube 72 is disposed within channel 70 and supported by tube holder 25, which in one embodiment includes a washer-shaped piece having a perimeter roughly congruent to the shape of interior channel 70.

End point 90 may be configured to be an outlet at one end of channel 70, with that end of channel 70 initially manufactured so that end point 90 closes one end of channel 70. This allows customization of a single piece, so that the exit holes may be drilled to suit the particular application. For example, a straight hole in facing surface 94 delivers liquid directly over embedded seed 50 (a "straight shooter"), which may be good for an insecticide, while side surfaces 92 may have holes drilled in them so that liquid is delivered on each side of embedded seed 50 (a "split shooter"), which may be better for fertilizer. In one embodiment (not shown), channel 70 is structured and arranged to accommodate multiple tube so that a series of end points are associated with each tube, allowing for combinations of straight shooters and split shooters in a single seed firmer.

Other embodiments have a tube disposed within the body of the firmer, for example the embodiments of FIGS. 6 and 10. The embodiment of FIG. 6 has flexing portion 640 coupling flat end 650 and embedding arm 680. Pipe 670 extends from embedding portion 680 and extends within portion 680 to spray nozzle 690. Pipe 670 is structured and arranged to receive a flexible tube (not shown) over its exposed end, and may have a roughed, serrated, or ridged surface to further engage the flexible tube. Firmer 600 may also have one or more tube retention pieces 675 to retain the flexible tube with firmer 600. Extender 610 engages embedding arm 680 as shown in FIG. 9 and described below. The embodiment of FIG. 10 has flexing portion 1040 coupling chute end 1050 and embedding arm 1080. Pipe 1070 extends from embedding portion 1080 and extends within portion 1080 to spray nozzle 1090. Pipe 1070 is structured and arranged to receive a flexible tube (not shown) over its exposed end, and may have a roughed, serrated, or ridged surface to further engage the flexible tube. Firmer 1000 may also have one or more tube retention pieces 1075 to retain the flexible tube with firmer 1000. Extender 1010 engages embedding arm 1080 as shown in FIG. 9 and described below.

Embodiments of the inventive firmers of the present application may be mounted on the planting equipment in a variety of ways. In one embodiment, as shown in FIG. 10, firmer 1000 includes seed chute connection portion 1050 structured and arranged to be connected to the exterior

mounting of a seed chute (not shown). In another embodiment, shown in FIG. 6, firmer 600 has flat end 650 so that firmer 600 may be attached within a planter bracket assembly similar to that disclosed in the aforementioned U.S. Pat. No. 7,497,174. Embodiments disclosed in the present application may be adapted to either mounting style.

In addition to the alternative styles of mounting to a seed chute (not shown), embodiments of the invention also have alternative arrangements of the replaceable embedding portion of the firmer. FIG. 6 shows firmer 600 having embedding end 680 with spray nozzle 690 and extender 610. Firmer also has flat end 650 merging into flexible arm 640 which resiliently biases embedding end 680. Liquid, such as pesticide, herbicide, and/or fertilizer, may be directed proximate embedding end 680 by a flexible tube (not shown) being engaged with arm 675 and attaching to fixed tube 670. Fixed tube 670 extends through embedding end 680 to nozzle 690. FIG. 7 shows a view of embedding end 680 from the perspective of the trailing embedded seed. Extender 610 is the portion of firmer 600 pushing a seed (not shown in FIG. 7) into the ground. In this embodiment, embedding end 680 generally narrows to the general size of the seed, with nozzle 690 extending over the location of the embedded seed.

Firmer 600 may have alternative versions of nozzle 690. In the alternative embodiment of FIG. 8A, central bore 800 extends through cylindrically shaped nozzle 690' and terminates at angled passages 810 and 820, which are structured and arranged to direct liquid to a position offset from the seed. Flange 830 extends outward to shield the space through which angled passages 810 and 820 direct fluid. Valley 840 is located proximate the open end of central bore 800, and is structured and arranged to be engaged by a ridge or bump within embedding end 680 to secure the position of nozzle 690'. The alternative embodiment of FIG. 8B has central passage 850 for directing fluid onto the seed. A further alternative embodiment is shown in FIG. 8C, which includes splitter 692 that attaches over nozzle 690' so that fluid coming through central passage 850 is directed in other directions through splitter holes 694, for example with similar angles as passages 810 and 820 of the embodiment of FIG. 8A. The exact shape, size, and angle of splitter holes 694 may be varied for several unillustrated alternative embodiments of splitter 692.

In the embodiment of FIG. 6, extender 610 engages embedding end 680. One embodiment of the connection of extender 610 and embedding end 680 is depicted in the arrangement of FIG. 9. In this arrangement, embedding end 680 has T-shaped tongue 684 extending from stop portion 682 and below bottom surface 686. Tongue 684 is structured and arranged to match the contour of recess 614 of extender 610. Near the end of tongue 684 opposite stop 682, bottom surface 686 has a recess portion 688. Recess portion 688 is structured and arranged to engage with ribs 612 which extend from extender 610. The engagement of ribs 612 with recess portion 688 allows extender 610 to be slid onto tongue 684 without any impediment, and when stop end 616 of extender 610 nears stop portion 682, then ribs 612 are close to engagement with recess portion 688 and thus provides a slide in and lock procedure for securing extender 610 with embedding end 680.

Other embodiments of the invention involve the firmer having a central portion with attachment, flexing, and embedding portions connected together by a sandwiching arrangement between corresponding sidewalls, for example the embodiments of FIGS. 11 and 12. In the embodiment of FIG. 11, firmer 1100 has flat end 1150, central portion 1140,

and embedding end 1180 formed in one integral piece. Pipe 1170 is disposed over embedding portion 1180, and under upper portion 1185, with extender 1110 abutting embedding portion 1180. Sidewalk 130 sandwich those components, and in some embodiments hold all together, using connectors 1145 received in sidewall holes 1135. In other unillustrated embodiments, extender 1110 may have a tongue-groove connection with embedding portion 1180, and be independent of, or alternatively sandwiched between, sidewalls 1130. Connectors 1145, which may be in the form of a screw, rod, putty, or other piece of connecting material and combinations of those, may secure sidewalls 1130 as sandwiching plates holding other components in their desired positions. In some embodiments, one or more connectors 1145 are releasable or otherwise alterable, while in other embodiments all connectors 1145 are fixed and engage sidewalls 1130, including extending through other components of firmer 1100. The embodiment of FIG. 12 has similar features to that of FIG. 11, with the exception that chute end 1250 being structured and arranged for connection to a conventional seed chute (not shown).

A further embodiment having separate attaching and embedding portions is shown in FIG. 13. In this embodiment, flexible portion 1340 and flat end 1350 (which could in another embodiment be replaced by a chute end, not shown here) are formed as a single integral piece, and embedding arm 1380 is formed as a separate piece. In this embodiment, pipe 1370 extends from connection portion 1350 to spray nozzle 1390, and the bottom of connection portion 1350 abuts flange 1330 of flexible portion 1340. Extender 1310 is connected to embedding arm 1380 with a tongue and groove connection similar to some previous embodiments. Connector 1345, which may be in the form of a screw, rod, putty, or other piece of connecting material, extends through flange 1330 to couple with connection portion 1350. In alternative embodiments (not shown), pipe 1370 may enter embedding arm 1380 above the overlap with flexible portion 1340 so that connector 1345 in that embodiment is affixed from the top.

Another embodiment shown in FIG. 14 has a two piece design for firmer 1400, with flexible portion 1440 having connection portion 1430 inserted into receiving portion 1435 or embedding portion 1480. In this embodiment, flat end 1450 may be alternatively shaped as a chute portion (not shown), and extender 1410 may be attached to embedding portion 1480 by a tongue and groove connection, or other connection.

An additional embodiment having a less substantial embedding portion is shown as firmer 1500 in FIG. 15. In this embodiment, flat end 1550 (which may alternatively be a chute end, not shown) has tube brackets 1575 disposed along flexible portion 1540 and embedding portion 1580 to provide for holding a tube (not shown) along the upper body of firmer 1500 to dispensing passage 1585 and spray nozzle 1590. Extender 1510, in this embodiment, may be attached to embedding portion 1580 via a tongue and groove connection, and is substantially thicker than those of the previous embodiments. This arrangement maximizes the size of replaceable extender 1510. Because of the greater size of extender 1510, the size of embedding portion 1580 is reduced. Thus, a pipe may not be feasible within embedding portion 1580, rather provision is made for attachment to flexible tube 1520. Flexible tube 1520 may be connected to a liquid delivery system (not shown) for dispensing water, nutrients, pesticides, and/or herbicides.

Seed firmers such as those described above as well as other types of firmers must be mounted to a plater properly

to be effective. A firmer should be attached in a position on the plater so that the embedding portion may contact the seed after it has been deposited in the furrow but before the furrow is closed. The firmer is typically also mounted in such a way that it is able to move and flex freely without interfering with the existing planter equipment. Many modern planters include a variety of devices such as disks, wheels, knives, and the like for opening, closing, and conditioning the soil as well as one or more tubes or chutes for delivering seeds as well as fertilizers, soil amendments, and treatments such as fungicides, pesticides, herbicides, and the like. Typically there is very little room on a modern planter for attaching a firmer mounting bracket so that it can be effective and not interfere with the operation of the planter and/or without making modifications to the placement and operation of the planter's existing attachments.

Firmer mounting bracket **1600** according to one embodiment of the present invention is shown in FIGS. **16-19**. In this particular example, mounting bracket **1600** includes mounting portion **1630** for securing the bracket to the planter and firmer attachment housing **1610** for removably securing firmer **1620** to bracket **1600**. Mounting portion **1630** is bolted to planter tool arm **1670** such that mounting bracket **1600** is disposed between opening disks **1640** of the planter which allows firmer **1620** to contact the ground aft of seed tube **1770**. In this particular example, mounting bracket **1600** is secured to planter tool arm **1670** using existing bolts **1660** which are already apart of the planter. Bolt **1660** passes through mounting arm **1680** portion of mounting portion **1630**. Mounting bracket **1600** in this example is installed without having to modify the planter or use additional hardware. In other examples, mounting points may be drilled or other otherwise machined into the planter tool arm and the mounting bracket secured to the planter using bolts or other fasteners not original to the planter. In still other examples, existing mounting points may be used in combination with aftermarket bolts, washers, bushings, or other fasteners adapted for use with the mounting brackets of the present invention.

As shown in FIG. **17**, in this example, positioning of mounting bracket **1600** between opening disks **1640** of the planter allows firmer **1620** to be disposed aft of seed tube **1770** which is typically disposed somewhere between the opening disks. Contacting portion **1690** of firmer **1620** may then press the seeds into the furrow before closing wheels **1700** cover the furrow with soil. Optionally, firmer **1620** may be equipped with one or more tubes or channels for delivering fertilizers or other amendments or substances to the furrow before closing by closing wheels **1700**. The exact positioning of firmer **1620** relative to opening disks **1640** and closing wheels **1700** may vary according to the particular planter and/or firmer being used.

The cover of firmer attachment housing **1610** has been removed in FIGS. **18-19** so the interior may be visible. The cover is secured to housing **1610** at one or more attachment points **1710** using screws, bolts, or other suitable fasteners. Optionally pins or other protrusions may be used to help insure the housing cover is correctly aligned with the housing when securing it. Housing **1610** includes at least one receiving chamber **1720** having opening **1730** for receiving and securing mounting end **1740** of the firmer. Housing **1610** may include additional openings **1750** as desired, such as to allow passage of fertilizer tube **1760** through housing **1610**.

Firmer **1620** is engaged with mounting bracket housing **1610** by sliding mounting end **1740** of firmer **1620** into housing opening **1730** until catch **1780** on the firmer snaps

into receiving slot **1790** in the housing. Once catch **1780** and slot **1790** are engaged with one another firmer **1620** is prevented from backing out of housing **1610**. To remove the firmer, a flat bladed tool such as a screwdriver or similar tool is inserted into housing opening **1730** between housing **1610** and firmer **1620** on the same side of the firmer as catch **1780**. Pressure is then applied to the tool to urge firmer **1620** away from housing **1610** which flexes firmer **1620** and causes catch **1780** to disengage slot **1790** thereby allowing firmer **1620** to be withdrawn from housing **1610**. A worn or broken firmer may then be replaced by a new firmer.

When in use, the size and configuration of housing **1610** and chamber **1720** allows firmer **1620** to flex to the degree necessary for effective performance. Because firmer **1620** is not fixed to housing **1610** in this particular example, firmer **1620** is free to flex along the entire length of firmer **1620** including portion **1740** inserted into mounting bracket **1600**. The exact amount of flexure required may vary according to a number of factors including soil composition, weather conditions, the type and variety of seeds being planted, and the like. The degree of flexure may be adjustable using an optional adjustment screw or bolt. Optional adjustment screw **1650** may be inserted into housing **1610** until the end of screw **1800** is the desired distance away from firmer **1620**. As the firmer flexes during use, the firmer contacts the screw which presents flexure beyond a predetermined range. In other examples, firmer **1620** may include protrusion **1810** which prevents flexure of the firmer beyond a predetermined degree by contacting wall **1820** of the housing. Such protrusion **1810** may be sized and/or positioned so as to allow as much or as little flexure as desired.

Another example of mounting bracket **2000** according to one embodiment of the present invention is shown in FIGS. **20-24**. In this particular example, mounting bracket **2000** includes mounting portion **2010** for securing the bracket to the planter and firmer attachment portion **2020** for removably securing a firmer to the bracket. Mounting portion **2010** is bolted to planter tool arm **2030** such that mounting bracket **2000** is disposed between the opening disks (removed for the sake of clarify) of the planter which allows firmer **2040** to contact the ground aft of seed tube **2050**. In this particular example, mounting bracket **2000** is secured to planter tool arm **2030** using bolts. Two bolts **2060** pass through mounting portion **2010**. Mounting bracket **2000** in this example is installed by modifying the planter by drilling two holes for mounting bolts **2060**. In other examples, existing mounting points and bolts or fasteners may be used. In still other examples, existing mounting points may be used in combination with aftermarket bolts, washers, bushings, or other fasteners adapted for use with the mounting brackets of the present invention.

Mounting bracket **2000** in the present example is positioned such that contacting portion **2080** of firmer **2040** may press seeds into a furrow prior to closing wheels **2070** closing the furrow and a firming or pressing wheel (not shown) firming the closed furrow. Optionally, firmer **2040** may be equipped with one or more tubes or channels for delivering fertilizers or other amendments or substances to the furrow before closing by closing wheels **2070**. The exact positioning of firmer **2040** relative to the opening disks and closing wheels **2070** may vary according to the particular planter and/or firmer being used.

In this particular example, mounting bracket **2000** does not include a bracket housing cover. Rather, firmer **2040** is secured to firmer attachment portion **2020** of bracket **2000** using screws, bolts, pins, straps, or other suitable means that serve as a housing. The exact nature of the attachment



mechanism varies according to the make, model, and/or style of firmer being used. In this particular example, firmer **2040** is secured to firmer attachment portion **2020** of the mounting bracket using strap **2090**, which in one embodiment includes a barrel band clamp. The general nature of 5  
firmer attachment portion **2020** in this example, having a generally smooth planar surface complementary to the surface of the firmer, allows a wide variety of makes and models of firmers to be used with bracket **2000**. Positioning of firmer **2040** relative to mounting bracket **2000** is optionally insured by matching protrusion **2100** on the firmer with a corresponding notch **2110** in firmer attachment portion **2020** as a receiving chamber. In other examples, the protrusion and notch may be of different size, shape, number, and/or configuration. In other examples, the firmer has one 10  
of more notches and firmer attachment portion **2020** has one or more protrusions which combined serve as a receiving chamber. In still other examples, each of the firmer and bracket has a mix of protrusions and notches. Firmer **2040** in this example includes mounting portion **2120** attached to flexible arm portion **2130**. The degree of flexure allowed by flexible arm portion **2130** is adjustable using screw **2140**. Flexure of arm **2130** is prevented beyond a desired set point by screw **2140** contacting mounting portion **2120** of firmer **2040**. By adjusting the length of screw **2140** protruding 15  
through flexible arm portion **2130**, the degree of flexure of firmer **2040** may be increased or decreased as desired.

Another example of an improved mounting bracket **2200** is shown in FIGS. **25-28**. In this particular example, mounting bracket **2200** is designed to be mounted to tool arm **2210** 20  
of the planter on the closing wheel assembly rather than on or near the opening wheel assembly of the previous examples. Mounting bracket **2200** comprises generally L-shaped member **2220** which is mounted to the closing wheel assembly such that the bracket projects forward of the closing wheels so as to position the firmer aft of the opening wheels but forward of closing wheels **2230**. Optionally, generally L-shaped bracket **2220** may be comprised of two or more portions bolted, screwed, or otherwise adjustably 25  
secured to one another. In this particular example, generally L-shaped bracket **2220** includes generally vertical bracket member **2240** secured using two bolts **2250**. The exact position of vertical bracket **2240** may be adjusted relative to the ground so as to adjust the depth to which firmer **2260** extends into a furrow. Once the desired firmer **2260** positioning is achieved, bolts **2250** may be tightened. Optionally, vertical bracket member **2240** and generally L-shaped member **2220** include multiple holes **2270** so a variety of positions may be achieved. L-shaped member **2220** may optionally include cross member **2280** to increase the strength and 30  
stability of bracket **2200**.

Mounting bracket **2200** is secured to planter tool arm **2210** using pre-existing bolt **2290** on an attachment point on the planter. Existing bolt **2290** is removed, the bracket positioned, and the bolt inserted through the bracket and 35  
tightened to the original planter specifications. Optionally, additional hardware such as washers, bushings, longer bolts, and the like may be used. In still other examples a new mounting point may be machined in the planter and new fasteners used where no suitable fasteners or attachment 40  
points exist.

Optionally firmer **2260** and/or bracket **2200** may include slot **2320** allowing for finer adjustment to the firmer depth. In this particular example, finer adjustment of firmer **2260** depth is achieved by loosening bolt **2310** which secures 45  
firmer **2260** to bracket **2200**, adjusting the positioning of firmer **2260** by sliding it up or down relative to bracket **2200**,

then tightening bolt **2310**. Optionally, slot **2300** is machined into the generally vertical member **2240** sized and configured so that mounting portion **2340** of firmer **2260** may slide 5  
therein. Seating of firmer mounting portion **2340** in slot **2310** helps prevent twisting of firmer **2260** during use.

In other examples, a generally L-shaped bracket designed for mounting to the closing wheel portion of the planter tool arm such as is shown in FIGS. **25-28** may be used in conjunction with firmer mounting systems such as the housing shown in FIGS. **16-19** or the system shown in FIGS. 10  
**20-24**. In other examples, the firmer mounting system shown in FIGS. **25-28** may be used in conjunction with a bracket that is mounted to the opening wheel portion of the planter tool arm.

A variety of factors may determine the optimal positioning of coulters during planting so as to achieve the desired seed positioning. Soil type (sandy, loamy, clay, etc.), soil moisture content, field litter (such as plant material from previous crops), and ground speed may all affect the quality 15  
of the furrow being opened by the coulters. If the coulters are fixed in position relative to one another then the operator must adjust other variables (such as ground speed during planting) or perform additional work to improve conditions (such as additional passes with implements to break up field 20  
litter or hard soil). Allowing the position of the coulters relative to one another to be adjusted allows the operator to achieve better furrow production and seed placement under a wider variety of field conditions.

While this invention has been described as having an exemplary design, the present invention may be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, 25  
uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains.

What is claimed is:

1. A bracket for attaching to a planter a seed firmer having a flexible arm portion and a firming portion for embedding seeds into soil, the planter having a seed chute and at least one closing wheel, the bracket comprising:

a mounting portion adapted to mount the bracket to an existing attachment point on a planter tool arm; and

a housing portion adapted to receive the flexible portion of a seed firmer having a protrusion on a first side of the flexible portion of the seed firmer and a catch on a second side of the flexible portion of the seed firmer, the housing portion comprising at least one first receiving chamber for receiving and securing the protrusion of the flexible portion of the seed firmer and at least one second receiving chamber for receiving and securing the catch of the flexible portion of the seed firmer;

wherein the seed firmer is secured to the bracket when the seed firmer is engaged with the first and second receiving chambers;

wherein the mounting portion is positioned on the planter tool arm such that the firming portion of the firmer is disposed aft of the planter seed chute and forward of the planter closing wheels.

2. The bracket of claim 1, wherein the firmer may be flexed to disengage the firmer protrusion from the receiving chamber allowing the firmer to be removed from the bracket.

3. The bracket of claim 1, wherein the mounting portion is bolted to a planter tool arm using an existing bolt on the planter.

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4. The bracket of claim 1, wherein the housing portion further includes an adjustment screw inserted therethrough which limits flexure of the flexible arm portion of the seed firmer.

5. The bracket of claim 1, wherein the housing portion further includes an opening allowing a liquid-carrying tube to pass therethrough from the planter to the firmer.

6. The bracket of claim 1, wherein the housing portion comprises two separable portions secured together with at least one fastener.

7. A bracket for mounting a seed firmer for embedding seeds into soil to a planter, said bracket comprising:

a mounting portion adapted to be mounted to an attachment point on a planter;

a receiving portion for receiving a flexible portion of the firmer adapted to be attached to the bracket;

wherein the receiving portion comprises a housing having a hollow chamber adapted to receive the flexible portion of the firmer;

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wherein the flexible portion of the firmer includes a protrusion and a catch disposed on opposite sides of the firmer and adapted to fit into the housing to secure the firmer to the housing.

8. The bracket of claim 7, wherein flexing the firmer disengages the firmer protrusion from the housing and allows the firmer to be removed from the bracket.

9. The bracket of claim 7, wherein the mounting portion is connected to the planter using an existing bolt on the planter.

10. The bracket of claim 7, wherein the receiving portion further includes an adjustment screw inserted therethrough which limits flexure of the flexible arm portion of the seed firmer.

11. The bracket of claim 7, wherein the receiving portion further includes an opening allowing a liquid-carrying tube to pass therethrough from the planter to the firmer.

12. The bracket of claim 7, wherein the receiving portion comprises two separable portions secured together with at least one fastener.

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